UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

MEMORANDUM

Date: 13-MAR-2012

SUBJECT: **Chlorothalonil.** Human-Health Assessment Scoping Document in Support of Registration Review.

PC Code: 081901
Decision No.: 455504
Petition No.: N/A
Risk Assessment Type: N/A
TXR No.: N/A
MRID No.: N/A

DP Barcode: D394659
Registration No.: N/A
Regulatory Action: Registration Review Scoping Document
Case No.: 97
CAS No.: 1897-45-6
40 CFR: §180.275

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Executive Summary

Introduction and Background

Chlorothalonil (2,4,5,6-tetrachloro-1,3-benzenedicarbonitrile) is a broad-spectrum, non-systemic protectant pesticide mainly used as a fungicide to control fungal foliar diseases of vegetable, field, and ornamental crops. It is also used as a wood protectant, anti-mold and anti-mildew agent, bactericide, microbiocide, algaecide, insecticide, and acaricide. Residential uses include golf courses, use on home gardens, use as a wood preservative, and use in paint formulations. Chlorothalonil-containing products are sold under the names Bravo, Echo, Daconil, Tuffguard, Busan 1192, Antiblu, and Densil. Since the Chlorothalonil Reregistration Eligibility Decision

(RED) was completed in 1999, the following commodities have been assessed and registered: edible-podded peas, ginseng, horseradish, lentil, lupin, okra, persimmon, rhubarb, yam, *Brassica* head and stem subgroup (5A), cucurbit vegetable group (9), fruiting vegetable group (8). The most recent human-health risk assessment for chlorothalonil was completed in 2010 (Memo, G. Kramer *et al.*, 12/23/10, D370486) in conjunction with a registration request for use on low-growing berry subgroup 13-07G, bushberry subgroup 13-07B, bulb onion subgroup 3-07A, and green onion subgroup 3-07B. HED and AD have evaluated the status of the human-health assessments for chlorothalonil to determine whether sufficient data are available and whether any updates are needed to support Registration Review. HED and AD have considered the most recent human-health risk assessments for chlorothalonil with respect to its toxicity, exposure, and usage databases, and the most updated Agency science policy and risk assessment methodologies to determine the scope of work necessary to support Registration Review.

Toxicology

The oral and inhalation routes of exposure are of the most toxicological concern with chlorothalonil. Based on acute toxicity studies, chlorothalonil is highly toxic via the inhalation route of exposure (Category I). There was a high level of lethality reported in the critical acute inhalation toxicity study (LC_{50} = 0.032 [M] and 0.013 [F] mg/L). RAB1, in conjunction with the HED Science Advisory Council for Toxicology (ToxSAC), believes that using any oral endpoint may underestimate risk via the inhalation route. The decision was based on the low fraction of the administered dose that was absorbed through the oral route (estimated at 14-20%), which may underestimate toxicity at a higher absorbed fraction (bioavailability) through the inhalation pathway. The lack of a no-observed adverse-effect level (NOAEL) in several acute inhalation toxicity studies carried out with technical-grade chlorothalonil or end-use product formulations is also a concern. Clinical signs consistent with respiratory-tract irritation (i.e., portal-of-entry effects) including nasal discharge, gasping, decreased activity, ptosis, and lethargy, were reported at all exposure concentrations tested across several acute inhalation toxicity studies for chlorothalonil. The effects of short- and intermediate-term inhalation exposures (portal-of-entry or systemic) have not been studied. In the absence of such information, HED recommends that the lowest-observed adverse-effect level (LOAEL) from the critical acute inhalation toxicity study with appropriate uncertainty factors (UFs) be used as the point of departure (POD) to assess inhalation risks (acute, short-, and intermediate-term). At this LOAEL, there were no deaths (male or female) and the very slight to slight (severity) clinical signs of respiratory distress resolved after two days post-exposure. The use of this LOAEL that is based on mild portal-of-entry effects is likely to be protective against any systemic toxicity through the inhalation route of exposure. If the registrant submits a subchronic inhalation study, with a subset of animals designed to identify the NOAEL for acute inhalation toxicity (i.e., after one day of exposure), then the current UFs may be reduced accordingly. Therefore, HED believes that the submission of a 90-day inhalation study (with acute toxicity measurements) is needed to refine the current residential risk assessments. Based on the lack of incident data related to inhalation effects and the fact that an acute inhalation toxicity study is being used to assess short- and intermediate-term risk, the risk assessment can be characterized as conservative.

Chlorothalonil exhibited low acute oral toxicity (Category IV), but in long-term (subchronic and chronic) oral dietary studies with rodents, chlorothalonil caused epithelial hyperplasia and hyperkeratosis at the limiting ridge and/or non-glandular region of the stomach. There were also kidney effects that included weight increase (relative and absolute), dilation of renal medullary tubules, pelvic dilation, tubular cysts, and tubular degeneration. In subchronic dietary studies with dogs, the reported effects included infiltration of inflammatory cells in the liver of both

sexes and decreased body-weight gains in males. The effects in a chronic dietary study with dogs included decreased body-weight gain and food consumption, macroscopic and microscopic pathological findings in the stomach that included thickened appearance and intra-epithelial nuclear pyknosis in the mucosal epithelium of the antrum, and a very slight cell hypertrophy in the zona fasciculata of the adrenal glands.

No specific malformations, or increase in malformations or reproductive effects attributable to administration of chlorothalonil were observed. In the 2-generation reproductive toxicity study, both parental animals and offspring exhibited pathological effects involving the stomach consisting of thickened and/or roughening of the forestomach with depressions in the epithelial aspect, and hyperplasia and hyperkeratosis of the non-glandular epithelium of the stomach. Based on overall weight-of-evidence, there is no evidence of increased susceptibility to offspring following *in utero* exposure to rats or rabbits in developmental toxicity studies or following pre/post-natal exposure in the reproductive toxicity studies in rats.

Chlorothalonil exhibited low acute toxicity via the dermal route of exposure (Category IV) and only caused moderate skin irritation (Category III). In longer-term dermal toxicity studies, the reported effects were local involving skin irritation (erythema) in the absence of any systemic toxicity. In the previous risk assessment, chlorothalonil was classified as not being a dermal sensitizer. However, a published literature study in mice and guinea pig ranks chlorothalonil as an extremely potent contact allergen, inducing sensitization using only topical exposures on intact skin. The data from this study will be evaluated in the registration review of chlorothalonil.

No appropriate acute endpoint was identified in the hazard database to quantitate the risk to the general population or to females 13-50 years old from single-dose oral administration of chlorothalonil. Therefore, there is no acute reference dose (aRfD) or acute population-adjusted dose (aPAD).

The chronic RfD (cRfD) is established based on the LOAEL from a chronic toxicity study in the rat. The LOAEL of 4.0 mg/kg/day is based on the increased incidence and severity of epithelial hyperplasia in the renal proximal convoluted tubules of female rats. The NOAEL is 2.0 mg/kg/day. This NOAEL is lower than any NOAEL in the database based on kidney effects. Although lower NOAELs/LOAELs were observed for gastrointestinal irritation in rodents, HED's Hazard Assessment and Policy Committee (HASPOC) determined that the forestomach lesions in rodent species should not be used for risk assessment due to the lack of a human forestomach counterpart.

Overall, there was no clear evidence that chlorothalonil was mutagenic. The Scientific Advisory Panel (SAP) concluded that the forestomach tumors chlorothalonil produced in rodents involved sustained cytotoxicity and regenerative cell proliferation as the mode of action and that a margin-of-exposure (MOE) approach would be appropriate. Quantification of excess lifetime cancer risk using a linear approach is, therefore, not required.

Quantification of dermal risk (all exposure scenarios) is not required since there is no systemic toxicity in a dermal toxicity study in rats at doses up to 600 mg/kg/day and the level of concern (LOC) for developmental toxicity and/or neurotoxicity is low.

Short- and intermediate-term incidental oral endpoints are based on kidney toxicity observed in the 90-day oral mouse study with a NOAEL of 41.3 mg/kg/day. A target MOE of 100 is

considered adequate for short and intermediate-term incidental oral and inhalation exposure.

After evaluating the toxicological database, HED identified the following factors supporting reduction of the Food Quality Protection Act (FQPA) Safety Factor (SF) from 10X to 1X for oral exposure assessments: 1) there are no significant data gaps in the hazard and exposure databases, 2) there are low concerns for pre- and/or postnatal toxicity, 3) there are no residual uncertainties with regard to pre- and/or postnatal toxicity, 4) the LOC for neurotoxicity is low, 5) there are no residual uncertainties in the exposure database, and 6) there was no evidence of immunotoxicity in the database. However, the chlorothalonil risk assessment team recommends setting the FQPA SF at 3X for acute and 30X for repeated residential inhalation exposure scenarios based on the lack of an inhalation study of appropriate duration to assess repeated exposures. There are only acute inhalation studies available for chlorothalonil. Its classification for acute inhalation toxicity is Category I (combined LC_{50} = 0.020 mg/L). The non-lethal effects reported in acute studies even at the lowest concentration tested (i.e., no NOAEL attained) consist of clinical signs indicative of respiratory-tract effects including nasal discharge, gasping/difficulty breathing, decreased activity/lethargy, respiratory rales/gurgle, ptosis, and piloerection. The effects of short- and intermediate-term inhalation exposures (portal-of-entry or systemic) have not been studied and justify retaining the FQPA SF at 10X for repeated exposure scenarios. Since there is no NOAEL available for any of the available acute inhalation studies, but the reported portal-of-entry effects were relatively mild at the LOAEL for the critical study, an additional 3X factor should be added to all exposure scenarios, resulting in an overall FQPA SF of 3X and 30X for acute and repeated inhalation exposures, respectively. Since the UFs applied to residential inhalation exposure assessment are related to uncertainty in the hazard database, the same factors are applied to the occupational assessment of inhalation exposure.

Dietary Exposure

The most recent dietary-exposure assessment was performed in conjunction with the December 2010 human-health risk assessment conducted by HED in conjunction with a registration request for use on low-growing berry subgroup 13-07G; bushberry subgroup 13-07B; onion, bulb subgroup 3-07A; and onion, green subgroup 3-07B (D370486, G. Kramer, *et al.*; 23-DEC-2010). HED was unable to make a safety finding due to inhalation risks and the proposed uses were subsequently withdrawn. An acute dietary-exposure assessment was not performed because no appropriate endpoint was available to determine the aRfD for the general population or any population subgroup. A partially refined chronic dietary-exposure assessment was performed using 100% crop treated (CT) for all crops; tolerance-level residues, and the Dietary Exposure Evaluation Model software with the Food Commodity Intake Database (DEEM-FCID™) 7.81 default processing factors for all foods except for tomatoes (average field-trial residues and empirical processing factors used), peppers (average field-trial residues used), orange juice (empirical processing factor translated from tomato juice), and snap beans (average field-trial residues used). Dietary risk estimates were determined considering exposures from food plus drinking water using estimated drinking water concentrations (EDWCs) for surface water sources provided by the Environmental Fate and Effects Division (EFED).

The resulting chronic dietary risk estimates for food and drinking water combined are below HED's LOC [i.e., <100% of the chronic population-adjusted dose (cPAD) of 0.02 mg/kg bw/day] for the overall U.S. population and all population subgroups. Using DEEM-FCID™, dietary risk is estimated at 41% of the cPAD for the U.S. population and 98% of the cPAD for children 1-2 years old, the population subgroup with the highest estimated chronic dietary exposure to chlorothalonil. Dietary cancer risk concerns due to long-term consumption of

chlorothalonil residues are adequately addressed by the chronic exposure analysis using the cPAD.

Residue Chemistry and Tolerances

The residue chemistry database is sufficient to support the current registrations. The following data requirement remains outstanding: multiresidue method recovery data for the 4-hydroxy metabolite.

The U.S., Canadian, and Codex tolerances/maximum residue limits (MRLs) for residues of chlorothalonil are generally not harmonized. For plant commodities, the U.S. and Canadian residue definitions are harmonized; however, the Codex residue definition is not harmonized, as it does not include the 4-hydroxy metabolite. The U.S. and Codex residue definitions for livestock commodities are harmonized and the U.S. and Codex have established MRLs for residues in cattle, goats, hogs, horses, and sheep commodities at different levels. Canadian MRLs are not established for residues in livestock commodities.

Residential Exposure

There is sufficient information available to assess residential exposure and risk from the conventional uses. The residential assessments that have been performed by HED are reflective of the currently registered residential uses, except for the use on home gardens. In the most recent risk assessment, **inhalation risk concerns for the short-/intermediate-term exposure durations were identified for residential handlers using treated paint, post-application exposure from inhaling vapors from treated paint, and for bystander volatilization inhalation exposure.** As noted above, there is no inhalation study of appropriate length available to assess short- and intermediate-term exposures, therefore, HED relied upon an acute study (in which no NOAEL was achieved) to assess short- and intermediate-term exposure. HED believes that the submission of a 90-day inhalation study (with acute toxicity measurements) is needed to refine the current residential risk assessments. Based on the lack of incident data related to inhalation effects and the fact that an acute inhalation toxicity study is being used to assess short- and intermediate-term risk, the risk assessment can be characterized as conservative.

Assessments may need to be conducted of the registered home garden uses. HED has revised its Residential Standard Operating Procedures (SOPs), including those used to determine exposure associated with treated paints/stains and home gardens. HED will incorporate new guidance from the updated SOPs to refine exposure estimates, as appropriate. In addition, in the most recent risk assessment, the Agency requested additional inhalation toxicity data that may affect the inhalation POD chosen for chlorothalonil. If changes are made, exposure scenarios may need to be reassessed.

With regard to the antimicrobial uses, there is potential for dermal and incidental oral exposure to pressure-treated wood that is used in residential structures such as porches and steps. These exposures were not assessed in the RED; therefore, they may need to be assessed during registration review. It will also be necessary to reassess the paint uses and determine if the precautionary labeling strategy required by the RED is still valid or if paints containing chlorothalonil should have labeling that can only be accomplished by having separate registrations for each paint product.

Occupational Exposures

There is sufficient information available to assess occupational handler and post-application exposure and risk for the conventional uses. In the most recent risk assessment, **inhalation risk concerns for occupational handlers were identified for both acute and short-/intermediate-term exposures.** As noted above, there is no inhalation study of appropriate length available to assess short- and intermediate-term exposures, therefore, HED relied upon an acute study (in which no NOAEL was achieved) to assess short- and intermediate-term exposure. HED believes that the submission of a 90-day inhalation study (with acute toxicity measurements) is needed to refine the current occupational risk assessments. Based on the lack of incident data related to inhalation effects and the fact that an acute inhalation toxicity study is being used to assess short- and intermediate-term risk, the risk assessment can be characterized as conservative.

Occupational handler scenarios may need to be reassessed during Registration Review to account for scenarios that have not been covered previously, updated exposure data, and changes to the toxicological PODs. In the most recent risk assessment, the Agency requested additional inhalation toxicity data that may affect the inhalation POD chosen for chlorothalonil. If changes are made, then exposure scenarios may need to be reassessed. During Registration Review, a review of the restricted-entry intervals (REIs) listed on the labels and the associated label language will need to be checked for consistency across products. A review of the labels will also need to be done to ensure all labels with registered turf uses include a statement prohibiting use on home lawns and other residential turf sites as required by the RED. In addition, a check of the ornamental label co-formulated with propamocarb will need to be done to ensure the revisions have been made regarding maximum allowable application rates.

With respect to the antimicrobial uses, the occupational handler exposures that occur from the use of chlorothalonil for material preservation were assessed in the RED; however, these assessments may also have to be repeated during registration review to account for changes in the toxicological PODs. In particular, the handler exposures from the open pouring of wettable powder will have to be reassessed because the antimicrobial wettable powder products are not packaged in water-soluble packaging as required by the RED. In addition, exposures that occur from the use of chlorothalonil as a wood preservative may have to be assessed because they were not assessed previously. These exposures can occur during both dip and spray treatments (i.e., sapstain treatment) and during pressure treatment.

Data Needs and Risk Assessment Updates Required:

Toxicology:

- The toxicity endpoint/dose selection along with the FQPA SF may need to be re-evaluated according to current policy.
- The following studies are required as specified in the revised 40 CFR Part 158:
    - Guideline 870.3465 90-day inhalation study (rat)
    - Guideline 870.7800 immunotoxicity, and
    - Guideline 870.6200 acute neurotoxicity.

Residue Chemistry:

- Guideline 860.1360 Multiresidue method recovery data for the 4-hydroxy metabolite.

- The tolerance expression for chlorothalonil residues needs to be updated to reflect current Agency policy under 40 CFR §180.275(a)(1): "Tolerances are established for residues of

chlorothalonil, including its metabolites and degradates, in or on the commodities in the table below. Compliance with the tolerance levels specified below is to be determined by measuring only chlorothalonil (2,4,5,6-tetrachloro-1,3-benzenedicarbonitrile) and its metabolite 4-hydroxy-2,5,6-trichloro-1,3-benzenedicarbonitrile, calculated as the stoichiometric equivalent of chlorothalonil, in or on the commodity," and under 40 CFR §180.275(a)(2): "Tolerances are established for residues of chlorothalonil, including its metabolites and degradates, in or on the commodities in the table below. Compliance with the tolerance levels specified below is to be determined by measuring only 4-hydroxy-2,5,6-trichloro-1,3-benzenedicarbonitrile in or on the commodity."

Dietary Exposure:

- A new dietary exposure and risk assessment may be conducted if there are changes to the chlorothalonil toxicological PODs and EDWCs.

Occupational/Residential Exposure:

- A revised occupational/residential exposure and risk assessment is required.

- The following studies are required for occupational/residential exposure assessment:
    - Guideline 875.1400 Indoor Exposure, Inhalation
    - Guideline 875.1600 Applicator Exposure Monitoring Data Reporting
    - Guideline 875.1700 Product Use Information
    - Guideline 875.2300 Surface Residue Dissipation

1.0 Introduction

Chlorothalonil (2,4,5,6-tetrachloro-1,3-benzenedicarbonitrile) is a broad-spectrum, non-systemic protectant pesticide mainly used as a fungicide to control fungal foliar diseases of vegetable, field, and ornamental crops. It is also used as a wood protectant, anti-mold and anti-mildew agent, bactericide, microbiocide, algaecide, insecticide, and acaricide. Residential uses include golf courses, wood preservatives, and use in paint formulations. Chlorothalonil-containing products are sold under the names Bravo, Echo, Daconil, Tuffguard, Busan 1192, Antiblu, and Densil. Since the Chlorothalonil RED was completed in 1999, the following commodities have been assessed and registered: edible-podded peas, ginseng, horseradish, lentil, lupin, okra, persimmon, rhubarb, yam, *Brassica* head and stem subgroup (5A), cucurbit vegetable group (9), fruiting vegetable group (8). The most recent human-health risk assessment for chlorothalonil was completed in 2010 (Memo, G. Kramer *et al*., 12/23/10, D370486) in conjunction with a registration request for use on low-growing berry subgroup 13-07G, bushberry subgroup 13-07B, bulb onion subgroup 3-07A, and green onion subgroup 3-07B. This petition was withdrawn when HED was unable to make a safety finding.

2.0 Hazard Identification/Toxicology

Chlorothalonil is a broad-spectrum, non-systemic protectant pesticide mainly used as a fungicide to control fungal foliar diseases of vegetable fields and ornamental crops. Its postulated mechanism of action as an antifungal agent involves disruption of sulfur-dependent enzymes that mediate energy production in the fungal organism. Its primary mode of action in mammals via the oral route of administration is similar in that it involves sulfur-dependent reactivity but differs in that nephrotoxic cysteine S-conjugates are generated through a bioactivation process in

the kidney.

In metabolism/pharmacokinetic studies, chlorothalonil at a dose of 1.5 mg/kg was rapidly absorbed via the oral route, reaching peak levels at 2-4 and 6 hours in the rat and dog, respectively. The fraction absorbed in the rat was estimated at 23% at 1.5 mg/kg bw and about 14% at 50 mg/kg bw. The plasma half-life of radiolabeled chlorothalonil in the rat at 1.5 mg/kg was longer in females (57.2 h) than in males (44.1 h), while being longest in the dog (74.2 h) at the same dose. At 50 mg/kg, peak levels of chlorothalonil in the rat were observed at 12 hours and, along with changes in maximum plasma concentration and area under the plasma concentration-time curve, suggest changes in absorption (rate and extent) at this higher dose. The majority of the radioactivity was recovered in the feces. Radioactivity did not appear to be retained significantly by any specific tissue, although it was detected in the kidneys at both doses at 120 hours post-dose. The metabolite profiles of the urine, bile, and tissue extracts show differences in the presence and proportions of the metabolites present, most notably the presence of mercapturic acid-containing moieties in the rat that were not detected in the dog.

The oral and inhalation routes of exposure are of the most toxicological concern with chlorothalonil. Based on acute toxicity studies, chlorothalonil is highly toxic via the inhalation route of exposure (Category I). There was a high level of lethality reported in the critical acute inhalation toxicity study (LC_{50} = 0.032 [M] and 0.013 [F] mg/L). RAB1, in conjunction with the HED ToxSAC, believes that using any oral endpoint may underestimate risk via the inhalation route. The decision was based on the low fraction of the administered dose that was absorbed through the oral route (estimated at 14-20%), which may underestimate toxicity at a higher absorbed fraction (bioavailability) through the inhalation pathway. The lack of a NOAEL in several acute inhalation toxicity studies carried out with technical-grade chlorothalonil or end-use product formulations is also a concern. Clinical signs consistent with respiratory-tract irritation (i.e., portal-of-entry effects) including nasal discharge, gasping, decreased activity, ptosis, and lethargy, were reported at all exposure concentrations tested across the available acute inhalation toxicity studies for chlorothalonil. The effects of short- and intermediate-term inhalation exposures (portal-of-entry or systemic) have not been studied. In the last risk assessment (G. Kramer, 12/23/10; D370486), a 90-day inhalation study was requested as condition for registration. No new inhalation studies have been submitted to the Agency and a 90-day inhalation study represents a pending data requirement. However, the registrants are working with the Agency to clarify the data needed to fulfill this data gap.

In the absence of such information, HED recommends that the LOAEL from the critical acute inhalation toxicity study with appropriate UFs be used as the POD to assess inhalation risks (acute, short-, and intermediate-term). At this LOAEL, there were no deaths (male or female) and the very slight to slight (severity) clinical signs of respiratory distress resolved after two days post-exposure. The use of this LOAEL that is based on mild portal-of-entry effects is likely to be protective against any systemic toxicity through the inhalation route of exposure. The methods and dosimetry equations described in EPA's RfC guidance (1994) were used for calculating human-equivalent concentrations (HECs) based on an inhalation toxicity LOAEL for use in MOE calculations. The regional deposited-dose ratio (RDDR), which accounts for the particulate diameter (mass median aerodynamic diameter [MMAD] and geometric standard deviation [σ_g] of aerosols), can be used to estimate the different dose fractions deposited along the respiratory tract. The RDDR is also based on interspecies differences in ventilation and respiratory-tract surface areas. Thus, the RDDR can be used to adjust an observed inhalation particulate exposure of an animal to the predicted inhalation exposure for a human. For the aerosolized chlorothalonil used in the critical acute inhalation toxicity study (Holbert, 1993), an

RDDR was estimated at 1.29 based on the reported MMAD of 2.35 µm and σ_g of 5.80 and the entire respiratory-tract surface area of the rat relative to the human. The details of these calculations are listed in the last risk assessment (G. Kramer, 12/23/10; D370486).

Chlorothalonil exhibited low acute oral toxicity (Category IV), but in long-term (subchronic and chronic) oral dietary studies with rodents, chlorothalonil caused epithelial hyperplasia and hyperkeratosis at the limiting ridge and/or non-glandular region of the stomach. However, effects related to forestomach irritation (i.e., hyperplasia and hyperkeratosis of the non-glandular area of the stomach) are not considered relevant for human health risk assessment due to the lack of a human forestomach counterpart (HED Cancer Assessment Review Committee (CARC)-HASPOC meeting in 2008). There were also kidney effects that are relevant for human-health risk assessment including weight increase (relative and absolute), dilation of renal medullary tubules, pelvic dilation, tubular cysts, and tubular degeneration. In subchronic dietary studies with dogs, reported effects included infiltration of inflammatory cells in the liver of both sexes and decreased body-weight gains in males. The effects in a chronic dietary study with dogs included decreased body-weight gain and food consumption, macroscopic and microscopic pathological findings in the stomach that included thickened appearance and intra-epithelial nuclear pyknosis in the mucosal epithelium of the antrum, and a very slight cell hypertrophy in the zona fasciculata of the adrenal glands.

In one of two rabbit developmental toxicity studies, there was an increased incidence of thirteen ribs and reduced sternebrae that represented a small (2x) quantitative difference in susceptibility between fetal and maternal effect levels. However, the difference is often observed in the particular strain of rabbit used and was not observed in another rabbit developmental study carried out in the same strain of rabbit and at the same doses of chlorothalonil. In one of two rat prenatal developmental toxicity studies, an increase in total resorptions per dam with a related increase in post-implantation loss was reported at a very high dose (400 mg/kg bw/day) in the presence of maternal toxicity (i.e., clinical signs of toxicity, decreases in body-weight gain, and food consumption). Similar findings were reported in a recently published mouse prenatal developmental toxicity study where very high doses of chlorothalonil (400-600 mg/kg bw/day) significantly affected the number of live fetuses, were associated with early resorptions, and caused fetal weight deficits, all in the presence of maternal toxicity (Faraq, *et al*.; 2006). In the 2-generation reproductive toxicity study, both parental animals and offspring exhibited pathological effects involving the forestomach that are not considered relevant for human health risk assessment. Based on the overall weight-of-evidence, there is no evidence of increased susceptibility to offspring following *in utero* exposure to rats or rabbits in developmental toxicity studies or following pre/post-natal exposure in the reproductive toxicity studies in rats. The developmental effects reported in the rat and mouse prenatal developmental toxicity studies only occur in the presence of severe maternal toxicity and only at high maternal doses.

The results of a subchronic neurotoxicity study with chlorothalonil did not reveal any signs of neurotoxicity, only body weight and food consumption deficits were reported. There is no acute neurotoxicity (ACN) study available for chlorothalonil. The Agency denied a waiver request for the ACN study requirement on the basis that the highest dose evaluated in that study was several orders of magnitude lower than the recommended limit dose without any dose-selection rationale provided. Moreover, several clinical observations in the LD_{50} studies are indicative of potential neurotoxicity, including ataxia, ptosis, decreased muscle tone, tremors, and nervousness. Neurotoxicity in the absence of lethality is more likely to be captured by an acute neurotoxicity study consisting of a robust functional-observational battery and motor-activity measurements. More details of the evaluation of the waiver by the Agency are provided in the 2010 risk

assessment (G. Kramer, 12/23/10; D370486)

Chlorothalonil has been classified as a "likely" human carcinogen by all routes of exposure based on an increased incidence of renal adenomas and carcinomas observed in both sexes of rats and mice. The mechanistic data, including the negative findings of all genetic toxicology testing, supported a non-neoplastic pathology as directly related to the eventual neoplasia and a non-linear mode of action for tumor production by chlorothalonil.

Chlorothalonil exhibited low acute toxicity via the dermal route of exposure (Category IV) and only caused moderate skin irritation (Category III). In longer-term dermal toxicity studies, the reported effects were local involving skin irritation (erythema) in the absence of any systemic toxicity. In the previous risk assessment (G. Kramer, 12/23/10; D370486), chlorothalonil was classified as not being a dermal sensitizer. However, a published literature study in mice and guinea pig ranks chlorothalonil as an extremely potent contact allergen, inducing sensitization through topical exposures on intact skin (Boman *et al*., 2000). The data from this study will be evaluated during registration review of chlorothalonil.

In the last risk assessment (G. Kramer, 12/23/10; D370486), there was no acute endpoint identified in the hazard database to quantitate the risk to the general population or to females 13-50 years old from single-dose oral administration of chlorothalonil. The cRfD and incidental oral endpoints (short- and intermediate-term) were based on kidney effects from rat chronic and subchronic studies, respectively. Dermal risk assessment (all exposure scenarios) was not performed based on the lack of systemic effects in rat dermal toxicity study in rats and the LOC for developmental toxicity and/or neurotoxicity being low. For inhalation exposure scenarios, an acute inhalation study was used with a composite FQPA SF of 30x applied to short- and intermediate-term residential inhalation exposures on the basis that there was no inhalation study of appropriate duration (only acute studies are available) available for assessing risk from repeated inhalation exposures. The composite FQPA SF of 30x was made up of 3x for the use of a minimal LOAEL (no NOAEL achieved) from the acute inhalation study and a 10x factor for the extrapolation of findings of an acute study to longer durations of exposure. Similarly, a composite database UF of 30x was applied to short- and intermediate-term occupational inhalation exposure for the same reasons listed above. Based on the lack of incident data related to inhalation effects, the application of these UFs can be characterized as being conservative. The registrant(s) has consulted the Agency regarding the design of an appropriate inhalation study to be submitted in the future. Once the appropriate inhalation study is submitted and evaluated by the Agency, some, if not all, the applied UFs can be reduced accordingly.

In future risk assessments of chlorothalonil, the FQPA SF may need to be updated based upon submission of pending toxicity studies including inhalation, acute neurotoxicity, and immunotoxicity studies (see below).

Immunotoxicity

An immunotoxicity study is required as a part of new data requirements in the 40 CFR Part 158 for conventional pesticide registration. Because the immune system is highly complex, studies not specifically conducted to assess immunotoxic endpoints are inadequate to characterize a pesticide's potential immunotoxicity. While data from hematology, lymphoid organ weights, and histopathology in routine chronic or subchronic toxicity studies may offer useful information on potential immunotoxic effects, these endpoints alone are insufficient to predict immunotoxicity. In the absence of required studies, EPA may use a database UF of up to 10X. An immunotoxicity study on chlorothalonil should be conducted. Once all data have been

received and reviewed, the chlorothalonil Registration Review Team recommends that the PODs and safety factors used for risk assessment purposes be reexamined and a new risk assessment done, if necessary.

Endocrine Disruption

As required by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Federal Food, Drug, and Cosmetic Act (FFDCA), EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic, and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints that may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of its most recent registration decision, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), chlorothalonil is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the Agency must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. Chlorothalonil was included on that list and has been issued an order to conduct the Tier 1 testing. Once all required Tier 1 and Tier 2 data have been received and reviewed, the endpoints and safety factors used for risk assessment purposes will be examined and a new risk assessment performed if necessary. For further information on the status of the EDSP, the policies and procedures, the list of 67 chemicals, future lists, the test guidelines and the Tier 1 screening battery, please visit our website: http://www.epa.gov/endo/.

Conclusions

The current toxicity database for chlorothalonil lacks the following studies according to the conditional and new 40 CFR Part 158 data requirements:

870.3465	90-day inhalation study (rat)
870.6200	Acute neurotoxicity study
870.7800	Immunotoxicity study

When the aforementioned studies are submitted, the current toxicity endpoint/dose selection may need to be re-evaluated along with the FQPA SF for future risk assessments.

3.0 Residue Chemistry

The qualitative nature of the residue in plants is adequately understood based on acceptable metabolism studies with carrots, celery, lettuce, snap beans, and tomatoes. The residues of concern are chlorothalonil and its 4-hydroxy metabolite, SDS-3701. The qualitative nature of the residue in livestock is adequately understood. The residue of concern in meat and milk is SDS-3701. Chlorothalonil *per se* has been shown to be so unstable in ruminant tissues that it is impractical to establish tolerances that include the parent.

The Pesticide Analytical Manual (PAM) Vol. II lists Method I, a gas chromatography/electron-capture detection (GC/ECD) method, for the enforcement of tolerances for plant commodities. The limit of quantitation (LOQ) is 0.01 ppm for both chlorothalonil and its 4-hydroxy metabolite. Samples of crop commodities from recently submitted field trials were analyzed for residues of chlorothalonil and its metabolite SDS-3701 using modified versions of the previously enforcement method entitled "Residue Analytical Method for the Determination of Chlorothalonil and R182281 in Crops." The lower limit of method validation (LLMV) was 0.01 ppm for each analyte using gas chromatography/mass-selective detector (GC/MSD) analyses.

The FDA PESTDATA database (dated 06/05) indicates that chlorothalonil is completely recovered (>80%) using FDA multiresidue method Sections 302 (Protocol D), 303 (Protocol E), and 304 (Protocol F). The database also contains information for chlorothalonil trichloro impurity (trichloroisophthalonitrile), which is recovered (no quantitative information available) using Sections 302 and 303 but is not recovered using Section 304. The database does not contain any information for the 4-hydroxy metabolite. In the Chlorothalonil Residue Chemistry RED Chapter, the multiresidue method recovery data for chlorothalonil trichloro impurity were incorrectly attributed to the 4-hydroxy metabolite; see DP# 228522, W. Smith. Multiresidue method recovery data for the 4-hydroxy metabolite thus remain outstanding.

Adequate crop field trial data are available to support the established tolerances on crops.

A 28-day ruminant feeding study has been reviewed and accepted by HED. HED recommended for the establishment of tolerances for the 4-hydroxy metabolite (SDS-3701) in meat and milk based on the results of this study. The requirement for a poultry feeding study was waived based on the results of the poultry metabolism study.

Adequate data pertaining to rotational crops are available. In response to an Agency evaluation of confined rotational crop data, the registrant submitted several rotational crop studies. These data indicated that the only residue that was detected in rotated crops was the soil metabolite SDS-46851 (3-carbamyl-2,4,5-trichlorobenzoic acid). Because of the low toxicity of this metabolite, an exemption for the requirement of a tolerance has been established for residues of SDS-46851 as inadvertent residues in rotated crops (40 CFR §180.1110). In addition, the registrant's request to delete rotational crop restrictions from chlorothalonil labels was approved.

Conclusions

The qualitative nature of the residue in plants and livestock is adequately understood. The residues of concern are chlorothalonil and its 4-hydroxy metabolite (SDS-3701). The residue chemistry database is sufficient to support the current registrations. The following data requirement remains outstanding: multiresidue method recovery data for the 4-hydroxy metabolite.

4.0 Dietary Exposure

The most recent dietary exposure and risk assessment was performed in conjunction with the December 2010 human-health risk assessment conducted by HED (D370486, G. Kramer, *et al.*; 23-DEC-2010). An acute dietary assessment was not performed because no appropriate endpoint was available to determine the aRfD for the general population or any population subgroup. A partially refined chronic dietary exposure and risk assessment was performed using 100% CT for all crops; tolerance-level residues, and DEEM-FCID™ 7.81 default processing factors for all foods except for tomatoes (average field-trial residues and empirical processing factors used), peppers (average field-trial residues used), orange juice (empirical processing factor translated from tomato juice), and snap beans (average field-trial residues used). Dietary risk estimates were determined considering exposures from food plus drinking water using EDWCs for surface water sources provided by EFED. Ground water sources were not included, as the EDWCs for this drinking water source are minimal in comparison to those for surface water.

The resulting chronic dietary risk estimates for food and drinking water combined are below HED's LOC [i.e., <100% of the cPAD of 0.02 mg/kg bw/day] for the overall U.S. population and all population subgroups. Using DEEM-FCID™, dietary risk is estimated at 41% of the cPAD for the U.S. population and 98% of the cPAD for children 1-2 years old, the population subgroup with the highest estimated chronic dietary exposure to chlorothalonil. Dietary cancer risk concerns due to long-term consumption of chlorothalonil residues are adequately addressed by the chronic exposure analysis using the cPAD.

EFED has provided Tier II EDWCs for use in drinking water assessments when chlorothalonil is used according to proposed labeling (Memo, R. Bohaty, 07-MAY-2010; DP# 370488). Because monitoring data are unavailable, estimates of chlorothalonil and the major degradate SDS-3701 concentrations were made only with mathematical models. The models PRZM/EXAMS were used to conduct surface water exposure assessments. EDWCs were generated for the total residues of concern for risk assessment; parent chlorothalonil and the major degradate SDS-3701 (G. Kramer, *et al*., 12/21/06; DP# 332752). This drinking water assessment (DWA) used revised input parameters to accurately reflect all scientifically available data, follow the most current input parameter guidance, and correct all erroneous values used in the previous DWA (DP# D346321); resulting in significantly lower EDWCs. The highest estimated surface water concentrations were associated with the Georgia onion application scenario. Water residues (surface water EDWC of 0.006 ppm) were incorporated in DEEM-FCID™ into the food categories "water, direct, all sources" and "water, indirect, all sources" for the chronic assessment.

Conclusions

The dietary-exposure database is adequate to support the existing registrations. However, a new dietary exposure and risk assessment may be required during Registration Review to incorporate potential changes to the chlorothalonil toxicological PODs and EDWCs.

5.0 Residential Exposure

Chlorothalonil is currently registered for use on turfgrass (including golf courses), home gardens, and is formulated into paints (for interior and exterior applications), coatings, adhesives, caulks, sealants, grout and joint compounds, wood stains, wood or wood structure protection treatments

(seasoned, unseasoned), and for mold control. A review was performed of the most recent Label Use Information System (LUIS) report (dated 9/14/11) prepared by the Biological and Economic Analysis Division (BEAD) to determine the current residential registrations, methods of application and maximum application rates for chlorothalonil. A summary of the home garden uses is provided in Table A4.2; the golf course uses are summarized as part of the occupational use summary in Table A4.1. Table A4.3 provides a summary of the registered paint uses. A summary of the antimicrobial uses is provided in Table A4.3.

Based on the registered uses, there is the potential for residential handler and post-application exposure, including the following: (1) post-application dermal and inhalation exposure from the use on golf courses; (2) handler and post-application dermal and inhalation exposure from the use on home gardens; (3) handler and post-application dermal and inhalation exposure from the use in treated paints. In the most recent risk assessment, exposures were assessed for residential handlers using treated paint, post-application exposure from inhaling vapors from treated paint, incidental ingestion of treated paint chips, and bystander volatilization inhalation exposure from the agricultural uses. The potential for residential post-application dermal exposure from the use on golf courses was identified; however, since no hazard had been identified via the dermal route for chlorothalonil, no quantitative assessment was conducted. Post-application inhalation exposure was also identified as a potential exposure pathway for golfers on treated courses, but the residential bystander assessment was expected to cover those potential exposures.

Residential Exposure to Paints

The most recent HED risk assessment (Memo, G. Kramer, 12/23/10, D370486) included an assessment of residential exposures from the use of treated paint, using the most up-to-date toxicological PODs. The residential exposure assessment included inhalation risk estimates for residential handlers using treated paint (Table A5.1), post-application inhalation risk estimates for residents from exposure to treated paint (Table A5.2), post-application incidental oral risk estimates for incidental ingestion of paint chips by children (Table A5.3), and a residential bystander assessment to address potential volatilization of chlorothalonil from treated fields (Table A5.4).

In that assessment, dermal risk was not quantified since no hazard was identified via the dermal route for chlorothalonil. The inhalation endpoint was revised from previous assessments and was based on effects observed in an acute inhalation study. The POD (a LOAEL of 0.002 mg/L) was converted to HECs for use in the exposure assessment for different durations. For acute inhalation exposures, the LOC was 100 (3X for interspecies factor extrapolation; 10X for intraspecies variations; and 3X for lack of NOAEL) and for longer-term durations, another 10x was added to account for the use of an acute duration study for longer-term exposures, making the LOC 1,000. The incidental oral endpoint was also revised from previous assessments and was based on effects in a 90-day oral mouse study, with a LOC of 100.

For residential handlers using treated paint, there were no inhalation risks of concern for the acute exposure duration (all MOEs >LOC of 100), but there were risks of concern for the short-term exposure duration (all MOEs <LOC of 1000). For post-application inhalation exposure, a chemical-specific study (MRID 43600102) was available that measured air concentrations in a room treated with chlorothalonil and the data were used to assess indoor post-application inhalation exposure. Using the available data, there were no risks of concern for acute exposures; however, there may be risks of concern for longer-term durations. There is no inhalation study of appropriate length available to assess short- and intermediate-term exposures, therefore, HED relied upon an acute study (in which no NOAEL was achieved) to assess short-

and intermediate-term exposure. HED believes that the submission of a 90-day inhalation study (with acute toxicity measurements) is needed to refine the current residential risk assessments. Based on the lack of incident data related to inhalation effects and the fact that an acute inhalation toxicity study is being used to assess short- and intermediate-term risk, the risk assessment can be characterized as conservative. An assessment was also conducted for incidental ingestion of paint chips by children. The short-term incidental oral MOE was greater than 100 and, therefore, was not of concern.

AD also assesses dermal irritation for products that have residential uses; however, this assessment was not included in the RED and will be done during registration review. Although not yet reviewed, there is a dermal toxicity study in rats (MRID 00158254) that indicates irritation effects occurred with a LOAEL of 2.5 mg/kg/day, which corresponds to a dose/concentration 2.5 mg/ml or 0.25 percent. This concentration is lower than the rates of 0.5 and 1.0 percent allowed for interior and exterior paints and suggests that dermal irritation risks may be of concern for antimicrobial uses of chlorothalonil only. This study will be formally reviewed during Registration Review and the results will be used to determine whether a quantitative dermal assessment is needed.

Residential Post-application Exposure to Pressure-Treated Wood

There is potential for dermal and incidental oral exposure to pressure-treated wood that is used in residential structures such as porches and steps. These exposures were not assessed in the RED; therefore, they may need to be assessed during registration review. There are three products (1022-584, 50534-115, 71581-2) that allow pressure treatment of wood. Product 71581-2 is labeled only for pressure treatment and can be applied to wood used for a variety of structures, including porches and steps. Product 1022-584 can be only applied as a co-ingredient with pressure-treatment solutions containing chromated copper arsenate (CCA) and the wood uses are not specified. Product 71581-2 can be used in a similar manner with the exception that the primary ingredient is not identified.

Residential Bystander Post-application Inhalation Exposure

The Agency developed a preliminary bystander volatilization inhalation exposure assessment for chlorothalonil utilizing currently available inhalation toxicity and air monitoring data. The chlorothalonil bystander volatilization inhalation exposure assessment compared the maximum air concentration detected in each of the monitoring studies to the acute HEC for residential bystanders. This comparison was done to represent a potential resident who lives next to a treated field and may be exposed to the peak concentration of chlorothalonil volatilizing off the field over a 24-hour period. In addition, the arithmetic mean chlorothalonil air concentration from each study was compared to the short-/intermediate-term HEC for residential bystanders. This comparison was done to represent a potential seasonal exposure. None of the air concentrations results in acute risks of concern; however, there were a couple of average air concentrations from some sites that resulted in short-/intermediate-term risks of concern.

Spray Drift

Spray drift is always a potential source of exposure to residents nearby to spraying operations. This is particularly the case with aerial application, but, to a lesser extent, could also be a potential source of exposure from the ground application method employed for chlorothalonil. The Agency has been working with the Spray Drift Task Force, EPA Regional Offices, and State Lead Agencies for pesticide regulation and other parties to develop the best spray drift management practices (see the Agency's Spray Drift website for more information at http://www.epa.gov/opp00001/factsheets/spraydrift.htm). On a chemical-by-chemical basis, the

Agency is now requiring interim mitigation measures for aerial applications that must be placed on product labels/labeling. The Agency has completed its evaluation of the new database submitted by the Spray Drift Task Force, a membership of U.S. pesticide registrants, and is developing a policy on how to appropriately apply the data and the AgDRIFT® computer model to its risk assessments for pesticides applied by air, orchard airblast and ground hydraulic methods. After the policy is in place, the Agency may impose further refinements in spray-drift-management practices to reduce off-target drift with specific products with significant risks associated with drift.

Conclusions

There is sufficient information available to assess residential exposure and risk for all of the residential uses except pressure-treated wood and paint. The residential assessments that have been performed by HED are reflective of the currently registered residential uses, except for the home garden and pressure-treated wood uses. In the most recent risk assessment, **inhalation risk concerns for the short-/intermediate-term exposure durations were identified for residential handlers using treated paint, post-application exposure from inhaling vapors from treated paint, and for bystander volatilization inhalation exposure.** As noted above, there is no inhalation study of appropriate length available to assess short- and intermediate-term exposures, therefore, HED relied upon an acute study (in which no NOAEL was achieved) to assess short- and intermediate-term exposure. HED believes that the submission of a 90-day inhalation study (with acute toxicity measurements) is needed to refine the current residential risk assessments. Based on the lack of incident data related to inhalation effects and the fact that an acute inhalation toxicity study is being used to assess short- and intermediate-term risk, the risk assessment can be characterized as conservative.

Assessments may need to be conducted for the registered home garden, treated paints/stains, and pressure-treated wood uses. HED has revised its Residential SOPs, including those used to determine exposure associated with treated paints/stains and home gardens. Registration review residential risk assessments will incorporate new guidance from the updated SOPs to refine exposure estimates as appropriate. In addition, in the most recent risk assessment, the Agency requested additional inhalation toxicity data that may affect the inhalation POD chosen for chlorothalonil. If changes are made, exposure scenarios may need to be reassessed.

6.0 Aggregate-Risk Assessment

The most recent aggregate-risk assessment was performed in conjunction with the December 2010 human-health risk assessment conducted by HED (D370486, G. Kramer, *et al.*; 23-DEC-2010). An acute aggregate-risk assessment was not performed because no appropriate endpoint was available to determine the aRfD for the general population or any population subgroup. A chronic aggregate exposure assessment takes into consideration dietary food + water exposure only. The chronic dietary estimates represent chronic aggregate risk. In aggregating short- and intermediate-term risk, the Agency routinely combines background chronic dietary exposure (food + water) with short- and intermediate-term residential exposure. Because there is no systemic hazard via the dermal route, and since incidental oral exposure from treated paint is considered to be episodic, only inhalation exposures for homeowners applying chlorothalonil products could be included in the short- and intermediate-term aggregate risk assessment. However, as the endpoints for dietary exposure (kidney effects) and residential short-term inhalation exposure (clinical signs) being used for the current assessment are not the same, these exposures cannot be combined.

Conclusions

A new aggregate risk assessment may be required during Registration Review to incorporate potential changes to the chlorothalonil toxicological PODs and EDWCs.

7.0 Occupational Exposure

Chlorothalonil is used as a fungicide to control fungal diseases of agricultural crops, turf (including non-residential turf, commercial/industrial lawns, sod farms, and golf courses), conifers (including Christmas tree plantations and nurseries), and ornamentals (field- and greenhouse-grown). It is also used as a wood protectant, anti-mold and anti-mildew agent, bactericide, microbiocide, algaecide, insecticide, and acaricide. A review was performed of the most recent LUIS report (dated 9/14/11) prepared by BEAD to determine the current agricultural/commercial registrations, methods of application and maximum application rates for chlorothalonil. A summary of the information provided in the LUIS report is provided in Table A4.1. The current registrations include several Special Local Needs registrations.

Occupational Handlers

There is the potential for dermal and inhalation exposure to occupational handlers from the currently registered use pattern of chlorothalonil. In all past risk assessments, no chemical-specific data were available with which to assess potential exposure to pesticide handlers; therefore, occupational handler assessments were based primarily on surrogate unit exposures from the Pesticide Handlers Exposure Database (PHED). Recently, both the Outdoor Residential Exposure Task Force (ORETF) and Agricultural Handler Exposure Task Force (AHETF) have produced pesticide handler exposure monitoring data that the Agency is using in place of PHED[1]. As more-reliable data become available (such as that from the AHETF and ORETF), the Agency will continue to replace existing exposure data. As a result, occupational handler scenarios may need to be revisited during Registration Review. Previous risk calculations were typically based on the maximum application rates and assuming maximum area treated per day or gallons handled. Handler's exposure and risk were calculated at baseline (long pants, a long-sleeved shirt, no chemical-resistant gloves, and no respirator) and with personal protective equipment when necessary (e.g., chemical-resistant gloves, respirators, and engineering controls).

The most recent occupational handler exposure assessment was conducted in December of 2010 (Memo, K. Lowe, 23-DEC-2010; D371456). Numerous occupational handler scenarios have been assessed in the past; however, the toxicological PODs were revised for the most recent risk assessment and, therefore, only the exposure scenarios and resulting risk estimates from that assessment have been included in Table A6.1 of the attachments. As mentioned in the residential exposure section, dermal risk was not quantified in the most recent assessment since no hazard was identified via the dermal route for chlorothalonil and the inhalation assessment was conducted using a HEC calculated from a POD from an acute inhalation study. HED determined that inhalation risks were of concern for both acute exposures (i.e., MOEs were <100) and short-/intermediate-term exposure (i.e., MOEs were <1,000). Even though these risk estimates represent the latest toxicological information, the exposure scenarios may need to be revisited during Registration Review to account for the revised handler surrogate-exposure data now available.

[1] http://www.epa.gov/pesticides/science/handler-exposure-data.html

In a previous risk assessment (D353243), HED had recommended that additional personal-protective equipment (PPE) be added to labels that allowed applications via high-pressure handwands due to risk concerns. At the time, a dust/mist respirator (i.e., a PF5 respirator) was required to reach acceptable MOEs. During Registration Review, this scenario may need to be reassessed taking into account changes in both handler unit exposures and PODs to determine if a respirator is still necessary.

There is one label registered for chlorothalonil for use on ornamentals that is co-formulated with another active ingredient, propamocarb. In the most recent occupational exposure assessment for propamocarb (Memo, K. Lowe, 05-NOV-2009; D368432), a review of this label identified issues with the use directions that allowed for high application rates to be calculated, which resulted in risks of concern for handlers. HED, EFED, and RD recommended revisions to the labeled use directions to clearly indicate the maximum application rates allowable that would not result in worker and/or drinking water risks. Discussions with the registrants are currently on going and during Registration Review, the label will need to be checked to ensure the revised rates do not result in risks of concern for chlorothalonil.

The most recent HED risk assessment did not cover all formulations (i.e., did not assess exposure from the use of dry flowable and wettable powder formulations) and use sites currently registered for chlorothalonil. In addition, as mentioned above, for the scenarios that were assessed, the unit exposures for those scenarios have subsequently been revised. Therefore, representative scenarios that cover the currently registered chlorothalonil uses may need to be assessed during Registration Review to account for changes in exposure data and toxicological PODs.

With respect to the antimicrobial uses, the occupational handler exposures that occur from the use of chlorothalonil for material preservation were assessed in the RED; however, these assessments may also have to be repeated during registration review to account for changes in the toxicological PODs. In particular, the handler exposures from the open pouring of wettable powder will have to be reassessed because the antimicrobial wettable powder products are not packaged in water-soluble packaging as required by the RED. In addition, exposures that occur from the use of chlorothalonil as a wood preservative may have to be assessed because they have not been assessed previously. These exposures can occur during both during dip and spray treatments (i.e., sapstain treatment) and during pressure treatment.

Occupational Post-Application

In the case of chlorothalonil, there is a potential for post-application dermal exposure to workers following foliar and dip applications of chlorothalonil to agricultural crops, turf use sites, conifers, and ornamentals (both field and greenhouse grown). Since there is no dermal POD, an assessment of post-application dermal exposure and risk was not conducted and may not need to be conducted if no change is made. Based on the Agency's current practices, a quantitative occupational post-application inhalation exposure assessment was not performed for chlorothalonil at this time. However, a quantitative assessment of residential bystander risk (for individuals in or around treated fields) was done based on available air monitoring data for chlorothalonil. The assessment of bystander risk is expected to be protective of all potential occupational post-application inhalation exposures.

Since there is no dermal endpoint and a quantitative post-application dermal exposure/risk assessment was not conducted for chlorothalonil, the REI would normally be based on the acute toxicity categories of the active ingredient. Chlorothalonil is classified in Acute Toxicity

Category IV for acute dermal toxicity, Toxicity Category III for primary dermal irritation, and Toxicity Category I for acute inhalation toxicity and for primary eye irritation. For chlorothalonil, the REI would be 48 hours based on the Toxicity Category for primary eye irritation. However, the REI for chlorothalonil has been set at 12 hours previously because the available incident data indicate that irritation to worker's eyes can occur beyond the 48-hour REI [see Memo, M. Clock, 1/7/98, *The Revised HED Chapter of the Reregistration Eligibility Decision (RED) Document for Chlorothalonil*]. It was also noted that available residue dissipation data show that residues do not often dissipate significantly within 48 hours of application. In the absence of a model in which to assess reentry exposure to compounds that have adverse eye effects, previous assessments have made recommendations for specific label language/product stewardship in lieu of the interim 48-hour REI imposed by the Worker Protection Standard (WPS). During Registration Review, a review of the REIs listed on the labels and the associated label language will need to be checked for consistency across products.

Conclusions

There is sufficient information available to assess occupational handler and post-application exposure and risk, except for wettable powder formulations, wood preservatives, and paints. In the most recent risk assessment, **inhalation risk concerns for occupational handlers were identified for both acute and short-/intermediate-term exposures.** As noted above, there is no inhalation study of appropriate length available to assess short- and intermediate-term exposures, therefore, HED relied upon an acute study (in which no NOAEL was achieved) to assess short- and intermediate-term exposure. HED believes that the submission of a 90-day inhalation study (with acute toxicity measurements) is needed to refine the current occupational risk assessments. Based on the lack of incident data related to inhalation effects and the fact that an acute inhalation toxicity study is being used to assess short- and intermediate-term risk, the risk assessment can be characterized as conservative.

Occupational handler scenarios may need to be reassessed during Registration Review to account for scenarios that have not been covered previously, updated exposure data, and changes to the toxicological PODs. In addition, in the most recent risk assessment, the Agency requested additional inhalation toxicity data that may affect the inhalation POD chosen for chlorothalonil. If changes are made, exposure scenarios may need to be reassessed. During Registration Review, a review of the REIs listed on the labels and the associated label language will need to be checked for consistency across products. A review of the labels will also need to be done to ensure all labels with registered turf uses include a statement prohibiting use on home lawns and other residential turf sites as required by the RED. In addition, a check of the ornamental label co-formulated with propamocarb will need to be done to ensure the revisions have been made regarding maximum allowable application rates.

A review was performed of (1) the data requests from the RED, (2) the available submitted data for chlorothalonil, and (3) the granted data waiver requests. Table A7.1 of the attachments lists all of the submitted studies available for chlorothalonil and Agency reviews of the data. Data waiver requests were submitted and granted in 2006 for the following studies:

- 132-1a -- Foliar residue dissipation
- 133-3 -- Dermal passive dosimetry exposure
- 133-4 -- Inhalation passive dosimetry exposure
- 231 -- Estimated Dermal exposure – outdoors
- 232 -- Estimated Inhalation exposure - indoors

It was determined that additional handler and post-application studies for the conventional uses are not necessary at this point considering the data that have been received in recent years from various task forces (e.g., ORETF, Agricultural Reentry Task Force (ARTF), AHETF). In addition, since there currently are no dermal hazard concerns for the conventional uses of chlorothalonil, additional dislodgeable foliar residue and turf-transferable residue data are not required at this time.

Exposure data are required to assess occupational handler inhalation exposures from certain antimicrobial use scenarios including wood preservation (dip, spray and pressure treatment), open pouring of liquids and wettable powders during material preservation and application of treated paints.

8.0 Public Health and Pesticide Epidemiology Data

For this evaluation, the OPP Incident Data System (IDS) was utilized for pesticide incident data on the active ingredient chlorothalonil. Chlorothalonil acts primarily as a fungicide and mildewcide, but also has some activity as a bactericide, microbiocide, algaecide, insecticide, and acaricide. It is a broad-spectrum, non-systemic pesticide. Chlorothalonil is registered on a wide variety of sites including field, vegetable, and orchard crops; turf; and as a mildewcide to be added to paint and other surface treatments. The purpose of the database search is to identify potential patterns in the frequency and severity of the health effects attributed to chlorothalonil exposure. The IDS includes reports of alleged human health incidents from various sources, including mandatory FIFRA Section 6(a)(2) reports from registrants, other federal and state health and environmental agencies, and individual consumers. Since 1992, OPP has compiled these reports in IDS. IDS contains reports from across the U.S. and most incidents have all relevant product information recorded. Reports submitted to the IDS represent anecdotal reports or allegations only, unless otherwise stated in the report.

The Agricultural Health Study (AHS) is a high-quality, prospective epidemiology study evaluating the link between pesticide use and various health outcomes including cancer. The AHS includes private and commercial pesticide applicators and their spouses. The AHS includes information on use of 50 different pesticide active ingredients commonly used in agriculture.

Incidents resulting in higher severity outcomes reported by registrants and incidents reported directly to the Agency by non-registrants are recorded in an IDS module called the Main IDS module. This system stores incident data for death, major and moderate incidents (and some minor or no effects incidents that are reported as unique cases to the Agency), and it includes more details about the location, date and nature of the incident. Main IDS incidents involving only one pesticide are considered to provide more certain information about the potential effects of exposure from the pesticide. When an incident involves more than one pesticide, it is difficult to determine which effects are attributed to the pesticide being considered. The less-severe human incidents (minor, unknown, or no effects outcomes) are reported by registrants as counts called aggregate summaries and are recorded in a separate module called Aggregate IDS.

In Aggregate IDS, which contains exposures classified as minor, unknown, or no effects outcomes, from January 1, 2006 to November 2, 2011, there were 117 reported exposures involving chlorothalonil resulting in low severity. As discussed, there are relatively few details provided on the incidents in the Aggregate IDS module and these incidents are low severity.

For the Main IDS, from January 1, 2006 to November 2, 2011, there are 22 exposures reported for single chemical only in the database (20 exposure classified as resulting in a moderate outcome and 2 classified as major), and 12 additional exposures that involved more than one chemical. During the scoping phase of Registration Review, the higher severity exposures (those resulting in fatal or major outcomes) are considered in more detail. Additionally, as described above, incidents involving one pesticide are typically focused on because they are considered to provide more certain information about the potential effects of the particular pesticide. The higher severity exposures (those resulting in fatal or major outcomes) that involve chlorothalonil are described in Table 1 (two major outcomes).

Currently available research from the AHS does not provide strong evidence in support of an association between chlorothalonil and all cancers combined, or with lung, colorectal, and prostate cancers specifically, the only anatomical cancer sites for which authors were able to measure an association. The authors note that a link between the pesticide and kidney tumors, which have been reported in some animal studies, was not investigated in this study due to limited number of exposed cases to perform a robust statistical analysis. A preliminary study linked chlorothalonil exposure (yes/no) and monoclonal gammopathy of undetermined significance (MGUS), a pre-cursor biomarker of potential multiple myeloma malignancy; however, additional mechanistic and epidemiologic research is needed to clarify the nature of this relationship.

In general, both the Aggregate and Main IDS modules result in relatively high frequency of chlorothalonil exposures. Although most of these exposures resulted in low-severity outcomes, high-severity outcomes did occur. Based on the frequency and severity of incident cases and AHS results, for chlorothalonil, there may be a potential for exposure. These incident data may warrant further analysis in the preliminary risk assessment phase of Registration Review.

Table 1. Main IDS High-Severity Incidents Involving Chlorothalonil.

Chemical: Chlorothalonil			**PC code: 081901**	**Human Incidents**			
Incident Number	**Incident Date**	**Product Name**	**Reg. Number**	**City**	**State**	**Exposure Type***	**Incident Description**
017747 - 00505	5/30/06	GARDEN DISEASE CONTROL	000239-02522	PLAINFIELD	IL	HB	An unknown age adult female got the product on her arm and shoulder. About 3 weeks later she went to the hospital feeling dizzy and like she was falling to the right.
022933 - 00030	10/1/09	MULTI-PURPOSE FUNGICIDE DACONIL 2787	000239-02522		CA	HB	A senior (>65 years old) female sprayed her peach tree in fall of 2009 and spring of 2010. She has experienced episodes of high sed rate, low hemoglobin and pain in her hips and legs ever since.

* Severity Categories

H-A	Human Fatality	Death (if the person died)
H-B	Human Major	Major (if the person alleged or exhibited symptoms which may have been life-threatening, or resulted in adverse reproductive effects or in residual disability)
H-C	Human Moderate	Moderate (if the person alleged or exhibited symptoms more pronounced, more prolonged or of a more systemic nature than minor symptoms; and involved some form of treatment, even though symptoms were not life threatening and the person returned to his/her pre-exposure state of health with no additional residual disability)
H-D	Human Minor	Minor (if the person alleged or exhibited some symptoms, but they were minimally traumatic; the symptoms resolved rapidly and usually involve skin, eye or respiratory irritation)
H-E	Human Unspecified	Unspecified (if symptoms are unknown, unspecified or are alleged to be of a delayed or chronic nature that may appear in the future)

H	Human	Undetermined (an undetermined severity)

from 40 CFR § 159.184

9.0 Tolerance Assessment and International Harmonization

U.S. permanent tolerances (listed in 40 CFR 180.275) and Canadian and Codex maximum residue limits (MRLs) are summarized in Attachment 8. The U.S., Canadian, and Codex tolerances/MRLs for residues of chlorothalonil are generally not harmonized. For plant commodities, the U.S. and Canadian residue definitions are harmonized; however, the Codex residue definition is not harmonized, as it does not include the 4-hydroxy metabolite. Only tolerances/MRLs for residues in cherries and tomato are harmonized with Canada and Codex. Several tolerances/MRLs for residues in/on various commodities are harmonized with Canada (i.e., asparagus, carrots, celery, lentils, mushroom, parsnips, peaches, peanuts, and cucurbit vegetables), but not with Codex. Two tolerances/MRLs are harmonized with Codex (cranberry, bulb onions), but not with Canada. There are several U.S. tolerances for which there are not Canadian and/or Codex MRLs (e.g., almond, apricot, banana, blueberry, tropical fruits, edible-podded peas, plums, and fruiting vegetables except tomato). Several tolerances/MRLs for residues in/on various commodities are not harmonized between either the U.S., Canada, or Codex (e.g., dry bean seeds, *Brassica* head and stem subgroup, and potatoes). The U.S. and Codex residue definitions for livestock commodities are harmonized and the U.S. and Codex have established MRLs for residues in cattle, goats, hogs, horses, and sheep commodities at different levels. Canadian MRLs are not established for residues in livestock commodities. Codex has established MRLs for residues in barley, currants, gooseberry, grapes, leeks, Chinese onions, welsh onions, parsley, poultry commodities, strawberries, sugar beets, and wheat commodities; however, Canadian and U.S. tolerances/MRLs are not established for residues in these commodities. Mexico adopts U.S. tolerances and/or Codex MRLs for its export purposes.

10.0 Environmental Justice

Potential areas of environmental justice concerns, to the extent possible, were considered in the human-health risk assessment, in accordance with U.S. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," (http://www.hss.energy.gov/nuclearsafety/env/guidance/justice/eo12898.pdf). The OPP typically considers the highest potential exposures from the legal use of a pesticide when conducting human-health risk assessments, including, but not limited to, people who obtain drinking water from sources near agricultural areas, the variability of diets within the U.S., and people who may be exposed when harvesting crops. Should these highest exposures indicate potential risks of concern, OPP further refines the risk assessments to ensure that the risk estimates are based on the best available information.

11.0 Human Studies

Past chlorothalonil risk assessments rely in part on data from studies in which adult human subjects were intentionally exposed to a pesticide to determine their dermal and inhalation exposure. Many such studies, involving exposure to many different pesticides, comprise generic pesticide exposure databases such as PHED, the ORETF Database, and the ARTF Database. EPA has reviewed all the studies supporting these multi-pesticide generic exposure databases, and has found no clear and convincing evidence that the conduct of any of them was either

fundamentally unethical or significantly deficient relative to the ethical standards prevailing at the time the research was conducted. All applicable requirements of EPA's Rule for the Protection of Human Subjects of Research (40 CFR Part 26) have been satisfied, and there is no regulatory barrier to continued reliance on these studies.

12.0 Data Requirements

Toxicology:

- The toxicity endpoint/dose selection along with the FQPA SF may need to be re-evaluated according to current policy.
- The following studies are required as specified in the revised 40 CFR Part 158:
  - Guideline 870.3465 90-day inhalation study (rat)
  - Guideline 870.7800 immunotoxicity, and
  - Guideline 870.6200 acute neurotoxicity.

Residue Chemistry:

- Multiresidue method recovery data for the 4-hydroxy metabolite (Guideline 860.1360).

- The tolerance expression for chlorothalonil residues needs to be updated to reflect current Agency policy under 40 CFR §180.275(a)(1): "Tolerances are established for residues of chlorothalonil, including its metabolites and degradates, in or on the commodities in the table below. Compliance with the tolerance levels specified below is to be determined by measuring only chlorothalonil (2,4,5,6-tetrachloro-1,3-benzenedicarbonitrile) and its metabolite 4-hydroxy-2,5,6-trichloro-1,3-benzenedicarbonitrile, calculated as the stoichiometric equivalent of chlorothalonil, in or on the commodity," and under 40 CFR §180.275(a)(2): "Tolerances are established for residues of chlorothalonil, including its metabolites and degradates, in or on the commodities in the table below. Compliance with the tolerance levels specified below is to be determined by measuring only 4-hydroxy-2,5,6-trichloro-1,3-benzenedicarbonitrile in or on the commodity."

Dietary Exposure:

- A new dietary exposure and risk assessment may need to be conducted to incorporate potential changes to the chlorothalonil toxicological PODs and EDWCs.

Occupational/Residential Exposure:

- A revised occupational/residential exposure and risk assessment is required.

- There are three exposures studies that are needed to assess occupational/residential exposure scenarios. These studies are listed in Table 2.

Table 2. Exposure Studies Needed for Chlorothalonil Registration Review.		
Study Needed	**Guideline**	**Applicable Exposure Scenarios**
Inhalation Exposure, Indoor Exposure Monitoring Data Reporting	875.1400 875.1600	Open-pour liquids during material preservation[A,B] Open-pour wettable powders during material preservation[A,B] Brush/roller application of treated paints[B] Airless sprayer application of treated paints[B] Dip, spray, and pressure treatment of wood[B]
Surface Residue Dissipation	875.2300	Residential exposure to pressure-treated wood
Product Use Information	875.1700	A detailed written description is needed of all the antimicrobial uses of chlorothalonil to define and characterize exposure scenarios.

A. If the labels are amended to require closed mixing/loading, then the exposure study for this scenario can be waived.
B. It may be possible to use proprietary surrogate exposure data if data compensation issues can be addressed.

13.0 References

Table 3. Memoranda Relevant to Registration Review.			
Author	Barcode	Date	Title
G. Kramer, *et al.*	D370486	23-DEC-2010	**Chlorothalonil.** Registration Request for Use on Low-Growing Berry Subgroup 13-07G; Bushberry Subgroup 13-07B; Onion, Bulb Subgroup 3-07A; and Onion, Green Subgroup 3-07B. **Human-Health Risk Assessment.**
G. Kramer	D371455	23-DEC-2010	**Chlorothalonil**: Chronic Dietary (Food and Drinking Water) Exposure and Risk Assessment to Support a Petition For Tolerances on Low-Growing Berry Subgroup 13-07G; Bushberry Subgroup 13-07B; Onion, Bulb Subgroup 3-07A; and Onion, Green Subgroup 3-07B.
G. Kramer	D371454	23-DEC-2010	**Chlorothalonil.** Petition For Tolerances Low-Growing Berry Subgroup 13-07G; Bushberry Subgroup 13-07B; Onion, Bulb Subgroup 3-07A; and Onion, Green Subgroup 3-07B. **Summary of Analytical Chemistry and Residue Data.**
R. Bohaty	D370488	07-MAY-2010	Drinking Water Assessment for the IR-4 Registration of Chlorothalonil (Bravo Weather Stick®, 54%) and the Degradation Product, 4-Hydroxy-2,5,6-trichloro-1,3-dicyanobenzene (SDS-3701) for the New Uses On: Bulb Vegetables, Bushberries, and Low Growing Berries.
G. Kramer, *et al.*	D371946	18-FEB-2010	**Chlorothalonil.** Section 18 Emergency Exemption Registration Request For Use on Oranges in CA. **Human-Health Risk Assessment.**
G. Kramer	D370763	18-FEB-2010	**Chlorothalonil.** Request for Conditional Registration Bravo 825® (EPA Reg. No. 50534-201) to Add Uses on Fruiting Vegetables.
G. Kramer	D373460	18-FEB-2010	**Chlorothalonil**: Chronic Dietary (Food and Drinking Water) Exposure and Risk Assessment to Support Section 18 Registration Request For Use on Oranges in CA.
G. Kramer	D351364	01-MAY-2009	**Chlorothalonil** Technical Fungicide - Review of Residue Chemistry Studies Submitted by Vischim S.R.L.
L. Shanaman	D346321	02-APR-2008	Drinking Water Assessment for the IR-4 Registration of Chlorothalonil (Bravo Weather Stick®, 54%) and the Degradation Product, 4-Hydroxy-2,5,6-trichloro-1,3-dicyanobenzene (SDS-3701) for the New Uses on: Fruiting Vegetables, Cucurbit Vegetables, Okra, Persimmon, Horseradish, Rhubarb, Ginseng, Yam, Lupin, Lentils and Brassica Head and Stem Vegetables.
G. Kramer	D346319	04-SEP-2008	**Chlorothalonil.** Petition For Tolerances on *Brassica* Head and Stem Subgroup 5A, Cucurbit Vegetable Group 9,

Table 3. Memoranda Relevant to Registration Review.			
Author	Barcode	Date	Title
			Fruiting Vegetable Group 8, Ginseng, Horseradish, Lentil, Lupin, Okra, Persimmon, Rhubarb, Yam, Lychee, and Starfruit. **Summary of Analytical Chemistry and Residue Data.**
G. Kramer, *et al.*	D353243	09-OCT-2008	**Chlorothalonil.** Petition For Tolerances on *Brassica* Head and Stem Subgroup 5A, Cucurbit Vegetable Group 9, Fruiting Vegetable Group 8, Ginseng, Horseradish, Lentil, Lupin, Okra, Persimmon, Rhubarb, Yam, Lychee, and Starfruit. **Human-Health Risk Assessment.**
G. Kramer	D323612	03-MAR-2006	**Chlorothalonil** Technical Fungicide - Review of Residue Chemistry Studies Submitted by Vischim S.R.L.
G. Kramer, *et al.*	D337925	16-MAR-2007	#3E6795. **Chlorothalonil**: Updated Revised Risk Assessment for a Tolerance on Edible-Podded Peas Without a U.S. Registration.
L. Shanaman	D306584	04-AUG-2006	Further Refined Drinking Water Assessment Characterization for the Me Too Registration of Chlorothalonil and the Degradation Product, 4-Hydroxy-2,5,6-trichloro-1,3-dicyanobenzene (4-Hydroxy-2,5,6-tricloroisophthalonitrile; SDS-3701) in Surface Water.
G. Kramer	D332540	14-SEP-2006	**Chlorothalonil**: Preliminary Chronic Dietary Exposure Assessment for a Tolerance on Edible-Podded Peas Without a U.S. Registration.
G. Kramer, *et al.*	D332752	21-DEC-2006	PP#3E6795. **Chlorothalonil**: Revised Risk Assessment for a Tolerance on Edible-Podded Peas Without a U.S. Registration.
J. Tomerlin	D310791	09-FEB-2005	ARIA Risk Assessment: Chlorothalonil Human Health Exposure and Risk Assessment for a Tolerance Without a Registration in the United States on Edible Podded Peas (including snow peas and sugar snaps).
J. Tomerlin	D310791	15-DEC-2004	**Chlorothalonil**: Acute and Chronic Dietary Exposure Assessments for a Tolerance on Edible Podded Peas Without a US Registration
L. Rossi	EPA 738-R-99-004	April 1999	Chlorothalonil Reregistration Eligibility Decision (RED).
W. Smith	D257651	12-JUL-1999	CHLOROTHALONIL REREGISTRATION. Reassessment of Tolerance Exemption for the Soil Metabolite 3-carbamyl-2,4,5-trichlorobenzoic acid (40 CFR §180.1110).
M. Clock		07-JAN-1998	The Revised HED Chapter of the Reregistration Eligibility Decision (RED) Document for Chlorothalonil.
W. Smith	D232879	30-JUN-1997	Chlorothalonil Reregistration: List A Case No. 0097: Chemical No. 081901: ISK-Bioscience's Submission of Magnitude of the Residues of Chlorothalonil on Sweet Corn.
W. Smith	D237223	30-JUL-1997	PP#6F4611. Chlorothalonil. Petition Method Validation Results for the Metabolite SDS-3701.
M. Clock	D244490	10-JUN-1998	Chlorothalonil: HED Response to ISK Biosciences February, 1998 Comments on the HED Science Chapter (dated November 25, 1997).
S. Knizner	D249046	01-SEP-1998	HED Review of Chlorothalonil RED.
M. Clock		07-May-1997	The HED Chapter of the Reregistration Eligibility Decision Document (RED) for Chlorothalonil.
W. Smith	D240979	23-DEC-1997	PP#6F4611. Chlorothalonil. Revised Enforcement Method for the Metabolite SDS-3701.
W. Smith	D228522	10-AUG-1996	Chlorothalonil: Reregistration Case No. 0097: Chemical No. 08190: Comments from ISK Biosciences on the Chlorothalonil HED RED Chapter.

Table 3. Memoranda Relevant to Registration Review.			
Author	Barcode	Date	Title
W. Smith	D201522	13-JUN-1995	Chlorothalonil: List A Reregistration Case No. 0097: Chemical ID No. 081901: Product and Residue Chemistry Considerations to be Included in the HED Chapter of the Reregistration Eligibility Decision Document.
C. Lewis	D217313	17-JUL-1995	Exposure Assessment for Section 18 Use of Chlorothalonil and Propamocarb on Tomatoes.
C. Lewis	D220337	01-NOV-1995	Exposure Assessment for Section 18 Use of Chlorothalonil and Propamocarb on Tomatoes in Florida.
C. Lewis	D221016	29-NOV-1995	Exposure Assessment for Section 18 Use of Chlorothalonil and Propamocarb Hydrochloride on Irish Potatoes.
J. Evans	D201524	22-JAN-1997	Revised Occupational And Residential Exposure Assessment For The Chlorothalonil Reregistration Eligibility Decision (RED).
J. Evans	D201524	07-DEC-1995	Occupational And Residential Exposure Assessment For The Chlorothalonil Reregistration Eligibility Decision (RED).
J. Evans	D228520	20-AUG-1996	OREB Comments Regarding ISK Biosciences' Response To The HED Draft Chapter For The Chlorothalonil RED.
J. Evans	NA	08-MAY-1997	Revised Mixer/Loader/Applicator Exposure Estimates (Based On 100% Inhalation Absorption) For The Chlorothalonil Reregistration Eligibility Decision (RED).
J. Evans	NA	20-JUL-1999	Indiana Petition Request - Reduction Of REI From 48 Hours To 0 Hours For Applications Of Reduced Rate (0.78 Ai/Acre) Of Chlorothalonil To Muskmelons.
D. Smegal	D295139	16-JAN-2004	Chlorothalonil: Evaluation of new use for mold control on treated wood and wallboard in buildings to support a labeling amendment for CLORTRAM™ F-40 Flowable Fungicide (EPA Reg. No. 72304-1).
M. Dow	D318049	15-JUN-2005	Chlorothalonil-Requested Data Waivers
S. Tadayon	D327361	06-MAR-2006	Study Review: Determination of Dermal and Inhalation Exposure to Reentry Workers During Maintenance Activities in Golf Courses" (MRID# 467340-01), DP Barcode 327361.
M. Dow	D317058	21-DEC-2006	Chlorothalonil - Consideration of Request for Data Waivers by Vischim S.r.l.
M. Dow	D346460	14-JUL-2008	**CHLOROTHALONIL** – Exposure/Risk Assessment for the Proposed Uses of Chlorothalonil on Fruiting Vegetables, Cucurbits, Persimmon, Rhubarb, Horseradish, Ginseng, Yam, Okra, Lupin, Lentil, and Head and Stem Brassica.
J. Evans	D343367	30-MAR-2009	Secondary Review of AHETF Field Studies: AHE17-21.
K. Lowe	D371456	23-JUL-2010	**Chlorothalonil:** Occupational and Residential Exposure/Risk Assessment of Proposed Section 3 Uses on Strawberry (and other low growing berries), Bushberry (low bushberry subgroup, except cranberry) and Bulb Vegetables.
J. Dawson, *et al.*	D373605	11-MAR-2011	(RE-ISSUED) Health Effects Division (HED) Review of Agricultural Handler Exposure Task Force (AHETF) Monograph: Open Pour Mixing and Loading Dry Flowable Formulations (RE-ISSUED) Health Effects Division (HED) Review of Agricultural Handler Exposure Task Force (AHETF) Monograph: Open Pour Mixing and Loading Liquid Formulations

Table 3. Memoranda Relevant to Registration Review.			
Author	Barcode	Date	Title
			(RE-ISSUED) Health Effects Division (HED) Review of Agricultural Handler Exposure Task Force (AHETF) Monograph: Open Cab Ground Boom Application of Liquid Sprays
M. Crowley	D381148	28-APR-2011	Review of Agricultural Handler Exposure Task Force (AHETF) Closed Cab Airblast Applicator Exposure Monitoring Studies: AHE55, AHE56, AHE57, AHE58, AHE59.
M. Crowley	D393093	22-SEP-2011	HED Secondary Review of Chlorothalonil Handler Exposure During Applications of Daconil 2787 Flowable Fungicide in Greenhouses.

Literature:

Faraq A.T., Karkour T.A., El Okazy A., Embryotoxicity of oral administered chlorothalonil in mice. Birth Defects Res B Dev Reprod. Toxicol. 2006 Apr:77(2):104-9.

Boman A., Montelius, J., Rissanen, R.L., and Liden, C. Sensitizing potential of chlorothalonil in the guinea pig and the mouse. Contact Dermatitis 2000, 273-279

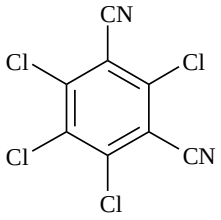
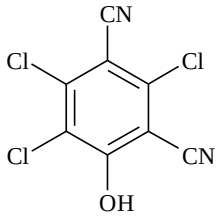
Lensen *et al.*, Contact Dermatitis Caused by Chlorothalonil on Imported Roses: Irritant or Allergic Reaction. Contact Dermatitis, Volume 65, Issue 1, pp 50 –U97, 2011.

Attachments:

Attachment 1: Chemical Identity Table.
Attachment 2: Chlorothalonil Endpoint Selection Tables.
Attachment 3: Exposure Potential for Adult and Child Aggregate Risk Estimates.
Attachment 4: Occupational Use Patterns/Exposure Scenarios for Chlorothalonil.
Attachment 5: Residential Handler and Post-application Scenarios Assessed and Risk Estimates.
Attachment 6: Occupational Handler Scenarios Assessed and Risk Estimates.
Attachment 7: Submitted Occupational/Residential Exposure Studies for Chlorothalonil
Attachment 8: Chlorothalonil International Residue Limit Status Sheet.

cc: K. Lowe (RAB1), G. Kramer (RAB1), C. Rodriguez (RAB1)
RDI: RAB1 (11/24/11), S. Knizner (12/20/11)
G.F. Kramer:S10957:PY-S:(703)305-5079:7509P:RAB1

Attachment 1: Chemical Identity Table.

TABLE A1. Test Compound Nomenclature.	
Compound	
Common name	Chlorothalonil
Company experimental name	N/A
IUPAC name	tetrachloroisophthalonitrile
CAS name	2,4,5,6-tetrachloro-1,3-benzenedicarbonitrile
CAS registry number	1897-45-6
Compound	
Common name	4-Hydroxy metabolite
Company experimental name	SDS-3701
IUPAC name	2,4,5-trichloro-6-hydroxyisophthalonitrile
CAS name	4-hydroxy-2,5,6-trichloro-1,3-benzenedicarbonitrile
CAS registry number	Not provided

Attachment 2: Chlorothalonil Endpoint Selection Tables.

Table A2.1. Summary of Toxicological Endpoints and PODs for Chlorothalonil Used in the 2010 Dietary and Residential Risk Assessment.

Exposure Scenario	Dose Used in Risk Assessment, UF		FQPA SF OR LOC	Study and Relevant Toxicological Effects
Acute Dietary-general population, including infants and children	N/A			An endpoint of concern (effect) attributable to a single dose was not identified in the database. Quantification of acute risk to general population including infants and children is not required.
Acute Dietary-females 13-49 years old	N/A			An endpoint of concern (effect) attributable to a single dose was not identified in the database. Quantification of acute risk to females 13-49 years old is not required.
Chronic Dietary-general population, including infants and children	NOAEL = 2.0 mg/kg/day UF = 100		FQPA SF = 1X cRfD = cPAD = 0.02 mg/kg/day	Chlorothalonil chronic toxicity/carcinogenicity – rat. LOAEL = 4.0 mg/kg/day, based on kidney effects consisting of epithelial hyperplasia in the renal proximal convoluted tubules of female rats.
Short-Term (1-30 days) Incidental Oral	NOAEL = 41.3 mg/kg/day		LOC = MOE = 100 (residential/recreational; includes the FQPA SF = 1X)	Chlorothalonil 90-day – mouse: LOAEL = 113 mg/kg/day, based on kidney effects consisting of minimal to slight (severity) hyperplasia of the epithelium of the proximal convoluted tubules.
Intermediate-Term (1-6 months) Incidental Oral	NOAEL = 41.3 mg/kg/day		LOC = MOE = 100 (residential/recreational; includes the FQPA SF = 1X)	
Short-(1-30 days) and Intermediate (1-6 months)-Term Dermal	N/A			Quantification of dermal risk is not required.
Acute Inhalation	LOAEL = 0.002 mg/L	HEC = 0.0004 mg/L	100 (3X interspecies, 10X intraspecies, 3X FQPA)	Chlorothalonil- Acute inhalation-rat: LOAEL = 0.002 mg/L based on clinical signs consisting of hypoactivity, gasping, lacrimation, nasal discharge, piloerection, ptosis, and respiratory gurgle.
Short-Term (1-30 days) Inhalation Intermediate-Term (1-6 months) Inhalation	LOAEL = 0.002 mg/L	HEC = 0.00006 mg/L	LOC = 1000 (3X interspecies, 10X intraspecies, 30X FQPA)	Chlorothalonil- Acute inhalation-rat: LOAEL = 0.002 mg/L based on clinical signs consisting of hypoactivity, gasping, lacrimation, nasal discharge, piloerection, ptosis, and respiratory gurgle.
Long-Term (>6 months) Inhalation	N/A			Long-term inhalation exposures are not expected to occur based on the registered/proposed uses.
Cancer (oral, dermal, inhalation)	**Classification:** "Likely" to be a human carcinogen by all routes of exposure (HED CPRC, 4th Meeting, 6/11/1997); however, the SAP decision (6/30/98) supports the use of an MOE approach in risk assessment for chlorothalonil. The HASPOC deliberated on 3/12/08 and supported the MOE approach.			

UF = uncertainty factor, FQPA SF = FQPA Safety Factor, NOAEL = no-observed-adverse-effect level, LOAEL = lowest-observed-adverse-effect level, RfD = reference dose (c = chronic), PAD = population-adjusted dose, MOE = margin of exposure,

LOC = level of concern, N/A = not applicable, CPRC = Carcinogenicity Peer Review Committee, SAP = Scientific Advisory Panel, HASPOC = Hazard Assessment and Policy Committee, HEC = human-equivalent concentration.

Table A2.2. Summary of Toxicological Endpoints and PODs for Chlorothalonil in the 2010 Occupational Exposure Risk Assessments.

Exposure Scenario	Dose Used in Risk Assessment	HEC	LOC for Risk Assessment	Study and Relevant Toxicological Effects
Short-(1-30 days) and Intermediate (1-6 months)-Term Dermal	N/A			Quantification of dermal risk is not required.
Acute Inhalation	LOAEL = 0.002 mg/L	0.001 mg/L	100 (3X interspecies, 10X intraspecies, 3X for no NOAEL)	Chlorothalonil- Acute inhalation- rat: LOAEL = 0.002 mg/L based on clinical signs consisting of hypoactivity, gasping, lacrimation, nasal discharge, piloerection, ptosis, and respiratory gurgle.
Short-Term (1-30 days) Inhalation		0.0003 mg/L	1000 (3X interspecies, 10X intraspecies, 3X for no NOAEL 10X for exposure duration)	
Intermediate-Term (1-6 months) Inhalation				
Long-Term (>6 months) Inhalation	N/A			Long-term inhalation exposures are not expected based on the registered/proposed uses.

NOAEL = no-observed-adverse-effect level, LOAEL = lowest-observed-adverse-effect level, LOC = level of concern, N/A = not applicable, HEC = human-equivalent concentration.

Attachment 3: Exposure Potential for Adult and Child Aggregate Risk Estimates.
(From D370486, G. Kramer, *et al.*; 23-DEC-2010)

Table A3. Summary of Chronic Dietary Exposure and Risk for Chlorothalonil (Food + Water).			
Age Group	cPAD (mg/kg/day)	Exposure (mg/kg/day)	% cPAD
General U.S. Population	0.02	0.008119	41
All Infants (<1 year old)	0.02	0.008653	43
Children 1-2 years old	0.02	**0.019630**	**98**
Children 3-5 years old	0.02	0.016483	82
Children 6-12 years old	0.02	0.010663	53
Youth 13-19 years old	0.02	0.006142	31
Adults 20-49 years old	0.02	0.006480	32
Adults 50+ years old	0.02	0.007754	39
Females 13-49 years old	0.02	0.006573	33

*The values for the highest exposed population for each type of risk assessment are bolded.

Attachment 4: Summary of Occupational and Residential Registered Uses Pulled From LUIS Report (dated 9/14/11).

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
Almond	Liquid	Aerial, Airblast	3	12 hr
	Dry Flowable			
Apricot	Dry Flowable	Aerial, Airblast	3.1	12 hr
	Liquid			12 hr
		Chemigation	3.1	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Asparagus	Liquid	Aerial, Groundboom	3	12 hr
	Dry Flowable			
Banana (SLN PR040006)	Liquid	Airblast	1.5	NS
Beans	Dry Flowable	Aerial, Groundboom, Chemigation	2.3	12 hr
	Liquid			
		Handheld equipment	0.01 lb ai/gal OR 2.3 lb ai/A	NS
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Blueberry	Dry Flowable	Aerial, Groundboom	3	12 hr
	Liquid			
		Handheld equipment	0.0033 lb ai/gal OR 3 lb ai/A	NS
Blueberry (SLN FL040007; MS050017)	Liquid	Groundboom	3	NS; except for MS050017 label lists 12 hr REI
Blueberry (SLN FL040008; GA040004)	DF			
Blueberry (GA040005)			0.27 gal/A	
Brassica	Liquid	Aerial, Groundboom, Chemigation	1.5	12 hr
Broccoli	Dry Flowable	Chemigation	1.16	12 hr
		Aerial, Groundboom	1.5	12 hr
	Liquid			24 hr
		Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Chemigation	1.43	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Brussels sprouts	Dry Flowable	Chemigation	1.16	12 hr
		Aerial, Groundboom	1.5	12 hr
	Liquid	Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Aerial, Groundboom, Chemigation	1.5	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Bulb vegetables	Liquid	Aerial, Groundboom, Chemigation	1.25	12 hr

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
Cabbage	Dry Flowable	Aerial, Groundboom	1.5	12 hr
		Chemigation	1.16	12 hr
	Liquid	Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Aerial, Groundboom	1.5	24 hr
		Chemigation	1.4	12 hr
Carrot	Dry Flowable	Aerial, Groundboom, Chemigation	1.5	12 hr
	Wettable Powder in Water Soluble Bags	Aerial, Groundboom, Chemigation	1.44	48 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Liquid	Aerial, Groundboom, Chemigation	1.5	12 hr
		Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
Cauliflower	Dry Flowable	Aerial, Groundboom	1.5	12 hr
		Chemigation	1.16	12 hr
	Liquid	Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Aerial, Groundboom	1.5	24 hr
		Chemigation	1.43	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Celery	Dry Flowable	Aerial, Groundboom, Chemigation	2.25	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Liquid	Aerial, Groundboom, Chemigation	2.31	12 hr
		Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
Cherry	Dry Flowable	Aerial, airblast	3.135	12 hr
	Liquid	Aerial, Airblast	3.1 lb ai/A OR 0.01 lb ai/gal	12 hr
		Chemigation	3.1	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Cole crops	WP in WSB	Aerial, Groundboom, Chemigation	1.08	48 hr
Commercial / Industrial Lawns	G	Spreader	11.31	NS
	Liquid	Groundboom, Handheld sprayers	11.44	12 hr
		Chemigation	11.3	12 hr
	Dry Flowable	Groundboom, Handheld sprayers	10.87	12 hr

Table A4.1. Occupational Registered Uses.

Use Site		Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
Conifers	Christmas tree plantations and Forest stands	Dry Flowable	Aerial, airblast	4.125	12 hr
	Seed beds; field grown and greenhouse	Dry Flowable	Chemigation	4.10 lb ai/A OR 1.44 lb ai/100 gallons	12 hr
	Christmas trees, nursery beds, and forest stands	Liquid	Aerial, Airblast	4.17	12 hr
		Liquid	Handheld equipment	0.0047 lb ai/gal OR 4.13 lb ai/A	NS
	Plantations, Nurseries, Forest Trees (SLN WA000014)	Dry Flowable	Airblast	2.1 lb ai/100 gal	12 hr
Corn		Dry Flowable	Aerial, Groundboom, Chemigation	1.5	12 hr
		Liquid			
		Liquid	Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Ready-to-Use	Sprayer	Apply to point of runoff	NS
Cranberry		Liquid	Aerial, Groundboom, Chemigation	5.25	12 hr
		Dry Flowable			
Cucumber		Ready-to-Use	Sprayer	Apply to point of runoff	NS
		Liquid	Aerial, Groundboom	1.36	48 hr
Cucurbits		Dry Flowable	Aerial, Groundboom, Chemigation	2.25	12 hr
		Liquid			
			Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
		Wettable Powder in Water Soluble Bags	Aerial, Groundboom, Chemigation	2.16	48 hr
Filbert (Hazelnut)		Dry Flowable	Aerial, Airblast	3	12 hr
		Liquid			
			Handheld equipment	0.0033 lb ai/gal OR 2.89 lb ai/A	NS
Fruiting vegetables		Liquid	Aerial, Groundboom, Chemigation	1.125	12 hr
Garbanzos [SLN WA020012 (L); OR030008 (DF)]		Liquid	Groundboom, Chemigation	1.5	12 hr
		Dry Flowable	Aerial, Groundboom, Chemigation		NS
Garlic		Dry Flowable	Aerial, Groundboom, Chemigation	2.25	12 hr
		Liquid			
			Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
		Ready-to-Use	Sprayer	Apply to point of runoff	NS
Ginseng		Liquid	Aerial, Groundboom, Chemigation	1.5	12 hr
Ginseng (SLN MI100002, WI100004)			Aerial, Groundboom		
Golf Course Turf		Granular	Spreader	11.31	NS

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
	Liquid	Groundboom, Handheld sprayers	11.44	12 hr
		Chemigation	8	12 hr
	Dry Flowable	Groundboom, Handheld sprayers	11.34	12 hr
Grasses grown for seed	Dry Flowable	Aerial, Groundboom, Chemigation	1.5	12 hr
	Liquid			
Horseradish	Liquid	Aerial, Groundboom, Chemigation	2.25	12 hr
Leek	Dry Flowable	Aerial, Groundboom, Chemigation	2.25	12 hr
	Liquid			
	Liquid	Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Lentils and Lupine	Liquid	Aerial, Groundboom, Chemigation	1.125	12 hr
Mango	Dry Flowable	Aerial, airblast	2.625	12 hr
	Liquid			
Melons	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Liquid	Aerial, Groundboom	1.36	48 hr
Mint	Dry Flowable	Aerial, Groundboom	1.03	12 hr
	Liquid			
Mint (SLN ND020009; OR990038)	Liquid	Aerial, Groundboom, Chemigation	1.05	12 hr on ND020009 48 hr on OR990038
Mint (SLN OR990037)	Dry Flowable	Aerial, Groundboom, Chemigation	1.03	12 hr
Mushrooms	Dry Flowable	Drench; Handheld equipment	11.3 lb ai/A OR 0.02 lb ai/gal OR	12 hr
	Liquid			
Nectarine	Dry Flowable	Aerial, Airblast	3.135	12 hr
	Liquid	Aerial, Airblast, Chemigation	3.1 lb ai/A OR 0.01 lb ai/gal	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Onion	Dry Flowable	Aerial, Groundboom, Chemigation	2.25	12 hr
	Liquid	Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
		Aerial, Groundboom, Chemigation	2.31	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Wettable Powder in Water Soluble Bags	Aerial, Groundboom, Chemigation	1.44	48 hr

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
Ornamentals (field-grown)	Dry Flowable	Airblast, Handheld equipment	1.55 lb ai/A OR 1.44 lb ai/100 gallons	12 hr
Ornamentals (in greenhouses)	Fogger/ Smoke generator	Fogger/Smoke Generator	1 3.5-oz can / 1000 ft2 (1.9 lb ai/A)	12 hr
Ornamentals grown in nurseries, greenhouses	Liquid	Handheld equipment	0.01 lb ai/gal	12 hr
Ornamentals (groundcover)	Dry Flowable	Groundboom, Handheld sprayers	3.10 lb ai/A OR 1.44 lb ai/100 gallons	12 hr
	Liquid	Aerial, Groundboom, Chemigation	3.1	12 hr
Ornamentals (including shade trees, herbaceous plants, non-flowering plants, woody shrubs, and vines)[a]	Liquid	Sprayer	0.01 lb ai/gal OR 48 lb ai/A[a]	48 hr
		Drench application	0.01 lb ai/gal OR 66 lb ai/A[a]	48 hr
		Drench application	0.01 lb ai/gal OR 85 lb ai/A[a]	48 hr
		Drench application	0.0003 lb ai/4-in pot (0.01 lb ai/gal)[a]	48 hr
Ornamentals (including foliage plants)	Liquid	Handheld equipment	2.1	12 hr
		Groundboom	0.02 lb ai/gal OR 3.1 lb ai/A	12 hr
	Dry Flowable	Aerial, Groundboom	3.1	
Ornamentals (including shrubs, trees, flowering plants, and bulbs)	Dry Flowable	Aerial, Airblast, Groundboom	1.55	12 hr
	Liquid	Aerial	0.01 lb ai/gal OR 1.56 lb ai/A	12 hr
		Handheld equipment	0.0085 lb ai/gal OR 1.11 lb ai/A	NS
Ornamentals (including shrubs, trees, flowering plants and bulbs, foliage plants)	Liquid	Airblast, Groundboom	1.35	NS
	Dry Flowable	Groundboom, airblast, handheld equipment	1.16 lb ai/100 gal	12 hr
Ornamentals (including shrubs/trees, foliage plants)	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Ornamental bulbs and corms	Dry Flowable	Dip	0.002 lb ai/gal	12 hr
Ornamentals (SLN CA030010)	Liquid	Dip	0.25 lb ai/corm	12 hr
Ornamentals (SLN OR000023; WA000003)	Dry Flowable	Dip	0.041 lb ai/gal	12 hr
Papaya	Dry Flowable	Aerial, Airblast	2.25	12 hr
	Liquid	Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
		Airblast	2.25	12 hr
		Aerial, airblast	2.15	NS
Parsnip	Dry Flowable	Aerial, Groundboom, Chemigation	1.5	12 hr
	Liquid	Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Aerial, Groundboom, Chemigation	1.5	12 hr
Passion Fruit	Dry Flowable	Airblast	1.5	12 hr

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
	Liquid	Handheld equipment	0.0076 lb ai/gal OR 1.65 lb ai/A	NS
		Airblast	1.5	12 hr
Peach	Dry Flowable	Aerial, Airblast	3.135	12 hr
	Liquid	Aerial, airblast	3.1 lb ai/A OR 0.01 lb ai/gal	12 hr
		Chemigation	3.1	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Peanuts	Dry Flowable	Aerial, Groundboom, Chemigation	1.125	12 hr
	Liquid	Aerial, Groundboom, Chemigation	1.172	12 hr
		Aerial	1.44	12 hr
Peas	Liquid	Aerial, Groundboom, Chemigation	1.5	12 hr
Persimmon	Liquid	Aerial, Airblast, Chemigation	0.9375	12 hr
Pistachio	Dry Flowable	Aerial, Airblast	4.5	12 hr
	Liquid	Aerial, Airblast	4.5 lb ai/A OR 0.023 lb ai/gal	12 hr
Plantain (SLN PR040006)	Liquid	Airblast	1.5	12 hr
Plum	Dry Flowable	Aerial, airblast	3.135	12 hr
	Liquid	Aerial, Airblast, Chemigation	3.1 lb ai/A OR 0.01 lb ai/gal	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Potato	Dry Flowable	Aerial, Groundboom, Chemigation	1.125	12 hr
	Liquid	Aerial	1.44	12 hr
		Handheld equipment	0.0057 lb ai/gal OR 1.24 lb ai/A	NS
		Aerial, Groundboom, Chemigation	1.125	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Wettable Powder in Water Soluble Bags	Chemigation	1.44	48 hr
Potato (SLN WI070006)	Dry Flowable	Aerial, Groundboom, Chemigation	1.12	12 hr
Potato (SLN MN030007)		Groundboom, Chemigation		NS
Potato (SLN ND030017)	Liquid	Aerial, Groundboom	0.78	12 hr
Potato (SLN WI040005)		Groundboom	0.84	12 hr
Potato (SLN MN030011, WI040006, WI100002)		Aerial, Groundboom	1.1	12 hr

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
Potato (SLN MN030008)		Groundboom, Chemigation		NS
Potato (SLN NE090002, ME100001)		Aerial, Groundboom, Chemigation		12 hr
Potato (SLN MI040001, MN030006, MN030010, ND030007)		Groundboom, Chemigation	1.12	12 hr
Potato (SLN ND030016)		Aerial, Groundboom		12 hr
Potato (SLN NE030004)		Groundboom		NS
Potato (SLN NE090001)		Aerial, Groundboom, Chemigation		12 hr
Potato (SLN WI100001)		Aerial, Groundboom	1.13	12 hr
Potato (SLN NE030005)		Groundboom	1.16	NS
Potato (SLN MI040002)		Groundboom, Chemigation	1.17	12 hr
Potato (SLN ND030008, WI070008)		Aerial, Groundboom, Chemigation		
Professional and Collegiate Athletic fields	Liquid	Groundboom, Handheld sprayers	11.44	12 hr
	Dry Flowable	Groundboom, Handheld sprayers	10.87	
Prune	Dry Flowable	Aerial, airblast	3.135	12 hr
	Liquid	Aerial, airblast	3.1 lb ai/A OR 0.01 lb ai/gal	12 hr
		Chemigation	3.1	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Pumpkin	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Liquid	Aerial, Groundboom	1.36	48 hr
Rhubarb	Liquid	Aerial, Groundboom, Chemigation	2.25	12 hr
Rose (field-grown)	Liquid	Aerial, Groundboom, Chemigation	1.08	NS
	Dry Flowable	Chemigation	1.10 lb ai/A OR 1.44 lb ai/100 gallons	12 hr
Shallot	Dry Flowable	Aerial, Groundboom, Chemigation	2.25	12 hr
	Liquid	Handheld equipment	0.01 lb ai/gal OR 2.27 lb ai/A	NS
		Aerial, Groundboom, Chemigation	2.25	12 hr
	Ready-to-Use	Sprayer	Apply to point of runoff	NS
Sod Farms	Liquid	Groundboom, Chemigation	13	12 hr
		Aerial	11.25	12 hr

Table A4.1. Occupational Registered Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A unless otherwise noted)	Re-entry Interval
	Granular	Spreader	11.31	24 hr
	Dry Flowable	Ground	11.34	12 hr
Soybeans	Dry Flowable	Aerial, Groundboom, Chemigation	1.9	12 hr
	Liquid	Aerial, Groundboom, Chemigation	1.69	12 hr
		Aerial	1.84	12 hr
Squash	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Liquid	Aerial, Groundboom	1.36	48 hr
Stone fruits	Dry Flowable	Aerial, Airblast	3.15	12 hr
	Liquid	Aerial, Airblast	3.13	12 hr
		Handheld equipment	0.0036 lb ai/A OR 3.09 lb ai/A	NS
Strawberry	Liquid	Aerial, Groundboom	1.125	12 hr
		Dip	0.011 lb ai/gal	12 hr
Strawberry (SLN CA960027)	Liquid	Dip	0.011 lb ai/gal	12 hr
Strawberry (SLN CA960027)		Aerial, Groundboom, Chemigation	1.12	12 hr
Sugarbeet (SLN OR990039)	Dry Flowable	Aerial, Groundboom	1.32	48 hr
Sugarbeet (SLN OR990040)	Liquid	Aerial, Groundboom, Chemigation	1.27	12 hr
Tomato	Ready-to-Use	Sprayer	Apply to point of runoff	NS
	Wettable Powder in Water Soluble Bags	Chemigation	2.16	48 hr
	Dry Flowable	Aerial, Groundboom, Chemigation	2.27	12 hr
	Liquid	Aerial, Groundboom, Chemigation	2.25	12 hr
		Handheld equipment	0.0095 lb ai/gal OR 2.06 lb ai/A	NS
Turf (with restriction on home lawns and other residential sites)	Granular	Spreader	11.31	NS
	Dry Flowable	Groundboom, Handheld sprayers	11.34	12 hr
	Liquid	Groundboom, Handheld sprayers	11.5	12 hr
Wood treatment (freshly sawed lumber or timber)	Liquid	Dip or spray	0.021 lb ai/gal	NS
		Paintbrush, Airless sprayer	0.105 lb ai/gal	NS
Yam	Liquid	Aerial, Groundboom	0.9375	12 hr

a. These uses and rates are associated with a label that includes both chlorothalonil and propamocarb as the active ingredients. The labels were not clear with respect to the maximum application rates allowed and, therefore, the highest rates able to be calculated were used in the risk assessment. Risks of concern were identified and HED, EFED, and RD recommended revisions to the labeled use directions to clearly indicate the maximum application rates allowable that would not result in worker and/or drinking water risks.

Table A4.2. Registered Residential Home Garden Uses.

Use Site	Formulation	Application Method Equipment	Maximum Application Rate (lb ai/A)
Apricot	Liquid	Handheld equipment	3.17 lb ai/A OR 0.0036 lb ai/gal
Beans	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Blueberry	Liquid	Handheld equipment	2.86 lb ai/A OR 0.0033 lb ai/gal
Broccoli	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Brussels sprouts	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Cabbage	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Carrot	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Cauliflower	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Celery	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Cherry	Liquid	Handheld equipment	3.17 lb ai/A OR 0.0036 lb ai/gal
Corn	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Cucumber	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Filbert	Liquid	Handheld equipment	2.86 lb ai/A OR 0.0033 lb ai/gal
Garlic	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Leek	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Melons	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Nectarine	Liquid	Handheld equipment	3.17 lb ai/A OR 0.0036 lb ai/gal
Onion	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Conifers	Liquid	Handheld equipment	4.45 lb ai/A OR 0.0051 lb ai/gal
Ornamentals (including trees, shrubs, flowering plants and bulbs, foliage plants)	Liquid	Handheld equipment	2.54 lb ai/A OR 0.0029 lb ai/gal
Papaya	Liquid	Handheld equipment	2.22 lb ai/A OR 0.0026 lb ai/gal
Parsnip	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Passion fruit	Liquid	Handheld equipment	1.59 lb ai/A OR 0.0073 lb ai/gal
Peach	Liquid	Handheld equipment	3.17 lb ai/A OR 0.0036 lb ai/gal
Plum	Liquid	Handheld equipment	3.17 lb ai/A OR 0.0036 lb ai/gal
Potato	Liquid	Handheld equipment	1.27 lb ai/A OR 0.0058 lb ai/gal
Prune	Liquid	Handheld equipment	3.17 lb ai/A OR 0.0036 lb ai/gal
Pumpkin	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Shallot	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Squash	Liquid	Handheld equipment	2.54 lb ai/A OR 0.012 lb ai/gal
Tomato	Liquid	Handheld equipment	1.9 lb ai/A OR 0.0088 lb ai/gal

Table A4.3. Registered Antimicrobial Uses.		
Use	**Application Rate**	**Notes**
Adhesives, Caulks and Sealants	4800 – 10019 ppm	Note 1
Composite Wood Products	4.8 to 5.05 pcf	
Grouts and Joint Compounds	15350 – 15680 ppm	
Paints, Stains and Coatings, Exterior Latex	2200-10100 ppm	
Paints, Stains and Coatings, Exterior Solvent	11500 -11800 ppm	
Paints, Stains and Coatings, Interior Latex	660 – 5000 ppm	
Paper and Paperboard (non-food)	1415 ppm	Note 2
Surface treatment of wood, wallboard concrete and masonry block in buildings	9790 - 10620 ppm (as a spray)	Note 3
Wood preservative applied by brush, spray or dip to lumber, timbers and particle board wood	250 - 23800 ppm	Note 4
Wood preservative applied by pressure treatment	0.8 pcf 200 – 500 ppm	Note 5 Note 6
Wood preservative stain applied to existing structures	10,100 ppm	
Note 1 – Labels have food contact prohibitions for caulks and sealants. Note 2 - The paper and paperboard use is only one label 74075-1. Note 3 – Interior sides of living spaces must be covered with overlayment materials. Note 4 – Only label #1022-589 has a maximum rate of 23,800 ppm. The other labels have a maximum rate of 10,800 ppm. Note 5 – Only two products (#71581-2 and #1022-580) specify the rate in terms of pounds per cubic feet (pcf). Note 6 – Added to the pressure treatment solution as a co-ingredient.		

Attachment 5: Residential Handler and Post-application Scenarios Assessed and Risk Estimates (from D371456).

Table A5.1. Risk Estimates for Residential Handlers

Exposure Scenario	Use pattern	Application Rate (lb ai/gallon)[a]	Acute Baseline Inhalation MOE[e] (LOC = 100)	Short-term Baseline Inhalation MOE[e] (LOC = 1000)
Mixing/Loading/Applying Liquids with a Paint Brush	painting with latex interior paint	0.048	1,300	**220**
	painting with latex exterior paint	0.096	670	**110**
	painting with alkyd exterior paint	0.11	580	**97**
Mixing/Loading/Applying Liquids with an Airless Sprayer	painting with latex interior paint	0.048	310	**52**
	painting with latex exterior paint	0.096	870	**140**
	painting with alkyd exterior paint	0.11	1,000	**170**

a. The application rate is based on the highest application rate for residential painting uses for chlorothalonil.
b. Science Advisory Council Policy # 12.
c. Unit Exposures based on PHED for the paintbrush scenario and from MRID 43600102 for the airless sprayer scenario. Baseline Inhalation: no respirator.
d. Dose = daily unit exposure (mg/lb ai) x application rate (lb ai/gal) x amount handled (gal) / body weight (70 kg adult).
e. MOE = HED (0.348 mg/kg/day) / Inhalation Dose (mg/kg/day).

Table A5.2. Residential Post-application Inhalation Exposure/Risk from the use of Treated Paint.

Sampling time	Measured air concentrations (mg/m^3)	MOEs	
0-6 hrs	0.00059	Acute (LOC = 100)	Short-/Intermediate-Term (LOC = 1,000)
6-12 hrs	0.00053		
12-18 hrs	0.00058		
18-24 hrs	0.00062		
Maximum air concentration:	0.00062	650	--
Average air concentration:	0.00058	--	100

Table A5.3. Residential Post-application Exposure and Risk from Ingestion of Paint Chips Containing Chlorothalonil Residues.

IgR (g/day)	Percent of ai in paint[a]	Fraction of ai available for ingestion	CF1 (mg/g)	BW (kg)	PDR[b] (mg/kg/day)	MOE[c] **(LOC = 100)**
0.04	0.48%	0.2	1,000	15	0.0026	16,000

a. % of ai in product is 40.4% however the % of ai in a gallon of paint is 0.48% (153.6 oz/12,800 oz x 40.4% = 0.48%).
b. PDR = potential dose rate = IgR x (Percent ai in paint) x Fraction of ai available for ingestion x CF1 / BW.
c. MOE = NOAEL (41.3 mg/kg/day)/PDR.

Table A5.4. Chlorothalonil Preliminary Volatilization MOE Analysis for Residential Bystanders.									
Study	Year of Study	Sampler/Site Location	Number of samples	Duration of samples	Duration of sampling period	Maximum Air Concentration (ng/m^3)	Arithmetic Mean Air Concentration (ng/m^3)	Acute MOEs[a] **(LOC = 100)**	Short-term MOEs[b] **(LOC = 1,000)**
Ambient Air Data									
Lompoc, CA (CalDPR)[c]	2000	Central	40	24-hour	2 months	4.29	1.27	93,000	47,000
		Northwest	40			4.29	1.07	93,000	56,000
		Southwest	40			4.29	1.34	93,000	45,000
		West	40			4.29	1.61	93,000	37,000
Fresno County, CA (CARB)[d]	1989	Cantua School, Cantua Creek	18	24-hour	1 month	3.5	--	110,000	--
		Martin Gunderson School, Five Points	19			3.5		110,000	
		U.C. Field Station, Five Points	19			3.5		110,000	
		Police Station, Huron	18			3.5		110,000	
		Fresno (ARB air-monitoring station; background site)	18			3.5		110,000	
Ventura County, CA (CARB)[e]	1990	Animal Control Shelter, Camarillo	30 (5 above the MDL)	24-hour	1 month	5	4	80,000	15,000
		Tierra Vista School, Oxnard	30 (none above MDL)			2	--	200,000	--
		Oxnard high School, Oxnard	30 (none above MDL)			2	--	200,000	--
		Ventura (Air Pollution Control District Office; background site)	30 (none above MDL)			2	--	200,000	--
Hastings, FL (PANNA)	2007	One drift catcher site located 65 ft southwest of cabbage field. Thirty-nine samples were collected over the monitoring period (October 1 - December 6, 2007). The Drift Catcher operator observed "spraying" or "fogging" on the mornings of October 13 and 29, and November 24.	39	24-hour (some multi-day)	2 months	555	134	720	**450**
MN (PANNA)[f]	2006/ 2007	Browerville Site 1 (~1/8 mi from hybrid poplar, ~3 mi from potatoes)	8 in 2006 and 13 in 2007	24-hour	1 month in 2006 and 1 month in 2007	29	5	14,000	12,000
		Browerville Site 2 (Within a few hundred yards of potatoes)	9 in 2006 and 10 in 2007		1 month in 2006 and 2 weeks in 2007	6	2	67,000	30,000

Table A5.4. Chlorothalonil Preliminary Volatilization MOE Analysis for Residential Bystanders.									
Study	Year of Study	Sampler/Site Location	Number of samples	Duration of samples	Duration of sampling period	Maximum Air Concentration (ng/m^3)	Arithmetic Mean Air Concentration (ng/m^3)	Acute MOEs[a] **(LOC = 100)**	Short-term MOEs[b] **(LOC = 1,000)**
		Browerville Site 3 (Within a few hundred yards of potatoes)	9 in 2006 and 10 in 2007		2 weeks in 2006 and 2 weeks in 2007	46	8	8,700	7,500
		Browerville Site 4	11		2 weeks in 2006	65	26	6,200	2,300
		Browerville Site 5	4		1 week in 2006	5	2	80,000	30,000
		Staples Site 1	4		1 week in 2006	0.5	0.5	800,000	120,000
		Staples Site 2	13		1 month in 2006	197	65	2,000	**920**
		Frazee Site (One sampler moved around, but generally within 1/2 mi of potato fields, sometimes within a few hundred feet)	67 in 2006 and 29 in 2007		2 months in 2006 and 2 months in 2007	190	31	2,100	1,900
		Waubun Site (No potatoes in vicinity of sampler)	15		1 month in 2006	0.5	0.5	800,000	120,000
Application Site Data									
San Joaquin County, CA (CARB)[g]	2002	North	Each site included 9 samples (including background sample)	Ranged from 1-hour to 24-hour samples; taken pre-application up to 3 days post-application	3 days	70	32	5,700	1,900
		Northeast				83	45	4,800	1,300
		East				737	324	540	**190**
		Southeast				413	262	970	**230**
		South				296	198	1,400	**300**
		Southwest				80	36	5,000	1,700
		West				372	127	1,100	**470**
		Northwest				29	17	14,000	3,500
Ventura County, CA (CARB)	1992	East Site 1	Ranch site included 8 samples (including background sample)	Ranged from 1-hour to 24-hour samples; taken pre-application up to 3 days post-application	3 days	158	74	2,500	**810**
		East Site 2				58	28	6,900	2,100
		West Sites 1 and 2				34	23	12,000	2,600

a. Acute MOE = Acute HEC (400,000 ng/m^3) / Study maximum air concentration (ng/m^3). LOC = 100.

b. Short-term MOE = Short-term HEC (60,000 ng/m^3) / Study arithmetic mean air concentration (ng/m^3). LOC = 1,000.

c. All non-detects and trace concentrations reported. For non-detects, assumed 1/2 Method Detection Limit (MDL) of 1.43 ng/m^3. For trace concentrations, assumed concentration halfway between MDL and Estimated Quantitation Limit (7.15 ng/m^3).
d. All samples were <MDL of 7.0 ng/m^3.
e. All sites except for Animal Control Shelter, were <MDL of 4 ng/m^3.
f. Samples analyzed by either PANNA lab (MDL ranged from 0.2 to 1.0 ng/m3, depending on analyte and when sample was analyzed and the GC parameters; estimated limit of quantitation ranged from 1.0 to 5.2 ng/m3, depending when sample was analyzed and GC parameters; and values marked "trace" indicate that a sample's concentration was between the MDL and LOQ) or Commercial lab (reporting limit for chlorothalonil-specific analysis: 10 ng/tube, or 3.5 ng/m3 assuming 24 h sample and 2.0 L/min flow rate). All of the sampling sites were adjacent to large fields. At some sites, sampling was timed to coincide with anticipated pesticide applications, while other sampling projects captured “ambient” pesticide concentrations.
g. Winds mostly out of West to Northwest.

Attachment 6: Occupational Handler Scenarios Assessed and Risk Estimates.

Table A6.1. Acute and Short-/Intermediate-term Occupational Handler Exposure and Risk Estimates for Chlorothalonil.

Exposure Scenario	App Rate (lb ai/acre)[a]	Area Treated Daily (acres)[b]	Acute MOE[g] (LOC = 100)				Short- and Intermediate-term MOE[g] (LOC = 1,000)			
			Baseline[c]	PF5 Respirator[d]	PF10 Respirator[e]	Engineering Control[f]	Baseline	PF5 Respirator	PF10 Respirator	Engineering Control
Mixer/Loader										
Mixing/Loading Liquids for Aerial Applications	3	350	**10**	**48**	97	140	**3**	**14**	**29**	**42**
Mixing/Loading Liquids for Chemigation Applications	3	350	**10**	**48**	97	140	**3**	**14**	**29**	**42**
Mixing/Loading Liquids for Groundboom Applications	3	80	**42**	210	420	610	**13**	**63**	130	180
Mixing/Loading Liquids via Dip	0.015 lb ai/gallon	100	6,800	34,000	68,000	98,000	2,000	10,000	20,000	29,000
		1000	680	3,400	6,800	9,800	200	1,000	2,000	2,900
Applicator										
Applying Sprays via Aerial Equipment	3	350	No Data	No Data	No Data	170	No Data	No Data	No Data	**51**
Applying Sprays via Groundboom Equipment	3	80	**69**	340	690	1,200	**20**	100	200	350
Flagger										
Flagging for Aerial Sprays Applications	3	350	**33**	170	330	1,700	**10**	**50**	99	500

a. The application rate was based on the highest application rate for the most recently proposed uses for chlorothalonil that included the low-growing berry subgroup 13-07G; bushberry subgroup 13-07B; onion, bulb subgroup 3-07A; and onion, green subgroup 3-07B.
b. ExpoSAC Policy # 9.1 and information from previous assessment on applications via dip (D327566).
c. Baseline Inhalation: no respirator.
d. PF5 Respirator: 80% protection factor provided by a NIOSH-approved quarter-face, cup-style respirator.
e. PF10 Respirator: 90% protection factor is provided by a NIOSH-approved half-face cartridge or canister respirator or a PAPR.
f. Engineering control for applying sprays via aerial equipment: enclosed cockpit.
g. MOEs based on comparison of calculated dose to human-equivalent doses (HED); HED = 0.174 mg/kg/day for acute exposures and HED = 0.052 mg/kg/day for short-and intermediate-term exposures.

Attachment 7. Submitted Occupational/Residential Exposure Studies for Chlorothalonil.

Table A7.1. Exposure / Residue Studies Submitted for Chlorothalonil.	
MRID - Study Citation	Agency Review
147976 Ballee, D. (1985) A Tomato Harvester Exposure Study with Chlorothalonil--1984: Document No. 655-3HE-84-0043-001. Unpublished study prepared by SDS Biotech Corp. 235 p.a	Data were reviewed and incorporated as part of revisions to Occupational Pesticide Post-application Exposure Data
42433810 Ballee, D. (1988) A Mixer, Applicator and Mower Exposure Study with Chlorothalonil for Golf Course Maintenance--1985: Lab Project Number: 1148-85-0051: 1148-85-0051-HE-001. Unpublished study prepared by Ricerca, Inc. 477 p.a	Data provided are superseded by newer submitted golf course maintenance studies (see below under ARTF); primary contractor reviews are available
42433811 Ballee, D. (1990) A Golfer Exposure Study with Chlorothalonil Used for Golf Course Maintenance--1985: Lab Project Number: 1148-85-0059: 1148-85-0059-HE-001. Unpublished study prepared by Ricerca, Inc. 264 p.a	
43600102 Formella, T. (1995) Potential Exposure of Workers to Chlorothalonil when Handling and Applying Paint Containing Chlorothalonil: Lab Project Number: 94-0204: ISKB-1894-002-02: 5227-94-0204-CR-001. Unpublished study prepared by Ricerca, Inc. 272 p. (43600101 = pilot study)a	Data were reviewed and incorporated as part of revisions to Occupational Pesticide Handler Exposure Data
43623202 King, C.; Prince, P.; Formella, T. (1995) Chlorothalonil Worker Exposure During Application of Daconil 2787 Flowable Fungicide in Greenhouses: Lab Project Number: 5968-94-0168-CR-001: 94-0168: SDS-2787. Unpublished study prepared by Ricerca, Inc 298 p. (43623201 = pilot study)	D393093
Agricultural Re-entry Task Force (ARTF) Studies -- Data were reviewed and incorporated as part of revisions to Occupational Pesticide Post-application Exposure Data	
45005904 Klonne, D.; Fuller, R.; Honeycutt, R. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Sweet Corn (Chlorothalonil): Lab Project Number: ARF009: 97-708HE: 017-03. Unpublished study prepared by H.E.R.A.C., Inc., and Centre Analytical Laboratories, Inc. 371 p.	Primary contractor reviews available
45005905 Klonne, D.; Fuller, R.; Honeycutt, R. (1999) Determination of Dermal and Inhalation Exposure from Chlorothalonil to Reentry Workers During Scouting in Sweet Corn: Lab Project Number: ARF010: 017-04: 97-709HE. Unpublished study prepared by H.E.R.A.C., Inc., and Centre Analytical Laboratories, Inc. 401 p.	
45005906 Klonne, D.; Artz, S.; Rotondaro, A. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Cauliflower (Chlorothalonil): Lab Project Number: ARF011: 97-295: 7443-98-0027-CR-001. Unpublished study prepared by Grayson Research LLC, and Ricerca, Inc. 387 p.	
45005907 Klonne, D.; Artz, S.; Prochaska, C. et al. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Cauliflower (Chlorothalonil): Lab Project Number: 97-296: ARF012: 98-0005. Unpublished study prepared by Grayson Research LLC, and Ricerca, Inc. 533 p.	
45005908 Klonne, D.; Artz, S.; Rotondaro, A. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Dry Peas (Chlorothalonil): Lab Project Number: ARF021: 98-326: 7608-98-0111-CR-001. Unpublished study prepared by Grayson Research LLC, and Ricerca, Inc. 361 p.	
45005909 Klonne, D.; Bruce, E.; Artz, S. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Sunflower (Chlorothalonil): Lab Project Number: ARF022: 44500: A048.007. Unpublished study prepared by ABC Laboratories, Inc. and Maxim Technologies, Inc. 318 p.	
45005910 Klonne, D.; Artz, S.; Bruce, E. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Grapes (Chlorothalonil): Lab Project Number: ARF023: ERS98011: 44835. Unpublished study prepared by ABC Laboratories, Inc., and Excel Research Services, Inc. 333 p.	
45005911 Klonne, D.; Artz, S.; Prochaska, C. et al. (1999) Determination of Dermal and Inhalation Exposure to Reentry Workers During Scouting in Tobacco (Chlorothalonil): Lab Project Number: ARF024: 98-327: ML98-0739-ART. Unpublished study prepared by Grayson Research, LLC. and Morse Laboratories, Inc. 335 p.	
45224801 Klonne, D.; Filler, R.; Howell, C. (2000) Determination of Dermal and Inhalation Exposure to Reentry Workers During Hand Line Irrigation in Potato: (Chlorothalonil): Lab Project Number: 45165: 10625-1: ARF036. Unpublished study prepared by ABC Laboratories and Ricerca, LLC. 417 p.	
45530101 Klonne, D.; Fuller, R.; Honeycutt, R. (2001) Determination of Dermal and Inhalation Exposure to Reentry Workers During Maintenance Activities on Golf Courses: Lab Project Number: ARF046. Unpublished study prepared by H.E.R.A.C. Inc. 420 p.	

Table A7.1. Exposure / Residue Studies Submitted for Chlorothalonil.	
MRID - Study Citation	Agency Review
45530102 Klonne, D.; Fuller, R.; Honeycutt, R. (2001) Determination of Dermal and Inhalation Exposure to Reentry Workers During Harvesting in Cabbage: Lab Project Number: ERS20020: ML00-0849-ART: ARF050. Unpublished study prepared by Excel Research Services, Inc. 345 p.	
45530103 Klonne, D.; Fuller, R.; Merricks, D. (2001) Determination of Dermal and Inhalation Exposure to Reentry Workers During Tying in Tomatoes: Lab Project Number: 3905: HL10267: ARF051. Unpublished study prepared by Agrisearch Inc. 382 p.	
46734001 Klonne, D.; Bruce, E. (2005) Determination of Dermal and Inhalation Exposure to Reentry Workers During Maintenance Activities in Golf Courses: (Chlorothalonil). Project Number: ARTF/ARF057, ARF057/MG, ARF057/CC. Unpublished study prepared by Agricultural Reentry Task Force and Ricerca Biosciences, LLC. 485 p.	D327361
Agricultural Handlers Exposure Task Force (AHETF) Studies -- Data were reviewed and incorporated as part of revisions to Occupational Pesticide Handler Exposure Data	
47212806 Bruce, E. (2007) Determination of Dermal and Inhalation Exposure to Workers in the Pacific Northwest During Open Pour/Mising Loading a Dry Flowable Pesticide Product and During Application to Various Sites by a Variety of Application Methods. Project Number: AHE18, 050186. Unpublished study prepared by Agricultural Handlers Exposure Task Force. 416 p.	D343367
47212808 Klonne, D. (2007) Determination of Dermal and Inhalation Exposure to Workers in Southern Georgia During Open Pour Mixing/Loading a Dry Flowable Pesticide Product and During Application to Various Sites by a Variety of Application Methods. Project Number: AHE20, 050188. Unpublished study prepared by Agricultural Handlers Exposure Task Force. 441 p.	
47212809 Klonne, D. (2007) Determination of Dermal and Inhalation Exposure to Workers in Northern Florida During Open Pour Mixing/Loading a Dry Flowable Pesticide Product and during Application to Various Sites by a Variety of Application Methods. Project Number: AHE21. Unpublished study prepared by Agricultural Handlers Exposure Task Force, LLC. 406 p.	
47259801 Klonne, D.; Holden, L. (2007) Agricultural Handler Exposure Scenario Monograph: Mixing and Loading Dry Flowable Formulations. Project Number: AHE1001. Unpublished study prepared by Agricultural Handlers Exposure Task Force. L.L.C. 107 p.	
47947801 Klonne, D.; Holden, L. (2009) Agricultural Handler Exposure Scenario Monograph: Open Pour Mixing and Loading Dry Flowable Formulations. Project Number: AHE1001. Unpublished study prepared by Agricultural Handler Exposure Task Force. 229 p.	D373605
47947802 Klonne, D.; Holden, L. (2009) Agricultural Handler Exposure Scenario Monograph: Open Pour Mixing and Loading of Liquid Formulations. Project Number: AHE1003. Unpublished study prepared by Agricultural Handler Exposure Task Force. 209 p.	
47947803 Bruce, E.; Holden, L. (2009) Agricultural Handler Exposure Scenario Monograph: Open Cab Groundboom Application of Liquid Sprays. Project Number: AHE1004. Unpublished study prepared by Agricultural Handler Exposure Task Force. 216 p.	
48303501 Smith, L. (2010) Determination of Dermal and Inhalation Exposure to Workers During Airblast Applications of Liquid Sprays Using Closed Cab Equipment in Michigan Stone Fruit. Project Number: AHE57. Unpublished study prepared by Agricultural Handler Exposure Task Force. 169 p.	D381148
48164901 Klonne, D.; Holden, L. (2010) Agricultural Handler Exposure Scenario Monograph: Closed Cab Airblast Application of Liquid Sprays. Project Number: AHE1005. Unpublished study prepared by Agricultural Handlers Exposure Task Force. 216 p.	Data were reviewed and incorporated as part of revisions to Occupational Pesticide Handler Exposure Data
47714402 Klonne, D.; Holden, L. (2009) Agricultural Handler Exposure Scenario Monograph: Open Cab Groundboom Application of Liquid Sprays. Project Number: AHE1004. Unpublished study prepared by Agricultural Handlers Exposure Task Force. 86 p.	
Dislodgeable Foliar Residue Studies	
42875902 Formella, T. (1993) Determination of Dislodgeable Foliar Residues of Chlorothalonil and HCB from BRAVO 720 Treated Cherry Trees: Lab Project Number: 5224-92-0069-CR-001. Unpublished study prepared by Ricerca, Inc. 212 p.a	No dermal hazard concerns currently (i.e., no quantitative dermal risk assessments necessary). Data will need to be reviewed if quantitative assessments required in future. Primary contractor reviews available for 42875902 and
42875903 Formella, T. (1993) Determination of Dislodgeable Foliar Residues of Chlorothalonil and HCB from BRAVO 720 Treated Broccoli Plants: Lab Project Number: 5224-92-0069-CR-002. Unpublished study prepared by Ricerca, Inc. 252 p.a	
42875904 Formella, T. (1993) Determination of Dislodgeable Foliar Residues of Chlorothalonil and HCB from BRAVO 720 Treated Cucumber Plants: Lab Project Number: 5224-92-0069-CR-003. Unpublished study prepared by Ricerca, Inc. 230 p.a	
44868601 Prochaska, L. (1999) Dissipation of Dislodgeable Foliar Residues of Chlorothalonil on Broccoli: Final Report: Lab Project Number: 468C-102: SARS-97-51: 97.388.	

Table A7.1. Exposure / Residue Studies Submitted for Chlorothalonil.	
MRID - Study Citation	Agency Review
Unpublished study prepared by Stewart Agricultural Research Services, Inc. and Wildlife International, Ltd. 202 p. {OPPTS 875.2100}	42875903
44868602 Prochaska, L. (1999) Dissipation of Dislodgeable Foliar Residues of Chlorothalonil on Sweet Corn: Final Report: Lab Project Number: 468C-104: SARS-97-53: SARS-97-CA-53. Unpublished study prepared by Stewart Agricultural Research Services, Inc. and Wildlife International, Ltd. 170 p. {OPPTS 875.2100}	
Turf Transferable Residue Studies	
45071501 Belcher, T. (2000) Daconol Ultrex and Daconil WeatherStik Transferable Turf Residue Study on Golf Course Greens: Lab Project Number: RR-99-072B. Unpublished study prepared by Zeneca Ag Products. 436 p. {OPPTS 875.2100}	No dermal hazard concerns currently (i.e., no quantitative dermal risk assessments necessary). Data will need to be reviewed if quantitative assessments required in future.
45064901 Belcher, T. (2000) Daconil Ultrex and Daconil WeatherStik Transferable Turf Residue Study on Golf Course Fairways: Lab Project Number: RR 99-071B: CHLO-99-TR-01: ERS-99011. Unpublished study prepared by GB Biosciences Corporation. 376 p. {OPPTS 875.2100}	
44901001 Hofen, J. (1999) Determination of Transferable Residues on Turf Treated With Chlorothalonil: Final Report: Lab Project Number: SARS-98-80: 7616-98-0160-CR: 7616-98-0160-CR-001. Unpublished study prepared by Stewart Agricultural Research Services, Inc., and Ricerca, Inc. 511 p. {OPPTS 875.2100}	

a. Studies were noted as submitted in RED

Attachment 8: Chlorothalonil International Residue Limit Status Sheet.

International Residue Limits

Chlorothalonil (081901; 10/14/11)

Summary of US and International Tolerances and Maximum Residue Limits				
Residue Definition:				
US		Canada	Mexico[1]	Codex[2]
40 CFR 180.275: Plant: chlorothalonil (tetrachloroisophthalonitrile) and its metabolite 4-hydroxy-2,5,6-trichloroisophthalonitrile Livestock: the metabolite 4-hydroxy-2,5,6-trichloroisophthalonitrile		Chlorothalonil tetrachloroisophthalonitrile, including the metabolite 4-hydroxy-2,5,6-trichloro-1,3-benzenedicarbonitrile		Plant : chlorothalonil. Livestock: SDS-3701 (2,5,6-trichloro-4-hydroxyisophthalonitrile). The residue is not fat-soluble.
Commodity	*Tolerance (ppm) /Maximum Residue Limit (mg/kg)*			
	US	Canada	Mexico[1]	Codex[2]
Almond	0.05			
Almond, hulls	1.0			
Apricot	0.5			
Asparagus	0.1	0.1		
Banana (NMT 0.05 ppm in edible pulp)	0.5			0.01 (*)[4]
Bean, dry, seed	0.1	5 beans 7 dry chickpeas 0.1 lentils		0.2 beans (dry)[4] 1 pulses[3]
Bean, snap, succulent	5			5 Common bean (pods and/or immature seeds)[4]
Blueberry	1.0	0.6		
Brassica, head and stem, subgroup 5A	5.0	5 broccoli, Brussels sprouts, cauliflower, cabbages		5 brocolli[4], 5 Brussels sprouts 6 Brussels sprouts[3] 1 cabbages, head[4], cauliflower[4] 5 Flowerhead brassicas (includes broccoli, broccoli Chinese and cauliflower)[3]
Carrot, roots	1	1.0 carrots		1[4] 0.3 root and tuber vegetables[3]
Celery	15	15		Celery 10; Celery 20[3] 3 celery leaves[4]
Cherry, sweet	0.5	0.5 cherries		0.5 cherries[4]
Cherry, tart	0.5	0.5 cherries		0.5 cherries[4]
Cocoa bean, dried bean	0.05			
Coffee, bean, green	0.20			
Corn, sweet, kernel plus cob with husks removed	1	0.02		
Cranberry	5.0	2.0		5[4]
Ginseng	4.0			0.3 root and tuber vegetables[3]
Horseradish	4.0			
Lentil	0.10	0.1		0.2 beans (dry)[4] 1 pulses[3]
Lychee	15			
Mango	1.0			

Summary of US and International Tolerances and Maximum Residue Limits				
Residue Definition:				
US		Canada	Mexico[1]	Codex[2]
Mushroom	1.0	1.0		
Nectarine	0.5			
Okra	6.0			
Onion, bulb	0.5	5.0 onions		0.5[4]
Onion, green	5			10[3] spring onion
Papaya	15			20[3]
Parsnip, roots	1	1.0 parsnips		0.3 root and tuber vegetables[3]
Passionfruit	3			
Pea, edible podded	5			
Peach	0.5	0.5 peaches/nectarines		0.2[4]
Peanut	0.3	0.3		0.05 0.1[3]
Pistachio	0.2			
Plum	0.2			
Plum, prune	0.2			
Potato	0.1	0.08		0.2[4] 0.3 root and tuber vegetables[3]
Rhubarb	4.0			
Soybean	0.2			0.2 beans (dry)[4] 1 pulses[3]
Starfruit	3.0			
Tomato	5	5.0		5[4]
Vegetable, cucurbit, group 9	5.0	5.0 balsam apples, balsam pears, cantaloupes, chayote fruit, Chinese cucumbers, Chinese waxgourds, citron melons, cucumbers, edible gourds (other than those listed in this item), muskmelons (other than those listed in this item) pumpkins, summer squash, watermelons, west Indian gherkins, winter squash		5 cucumber; squash, summer; winter squash[4] 3 cucumber[3], gherkin[3] Squash, summer[3] 2 melons, except watermelon 2 melons, except watermelon[3]
Vegetable, fruiting, group 8, except tomato	6.0			70 peppers Chili, dried[4] 7 peppers, Sweet (including pimento or pimiento)[4]
Yam, true	0.10			0.3 root and tuber vegetables[3]
US [40 CFR §180.275(a)(2)]		Canada	Mexico[1]	Codex[2]
Tolerances are established for the metabolite 4-hydroxy-2,5,6-trichloroisophthalonitrile in or on the following food commodities		Same as above		Same as above
Commodity	*Tolerance (ppm) /Maximum Residue Limit (mg/kg)*			
	US	Canada	Mexico[1]	Codex[2]
Cattle, fat	0.1			0.07 mammalian fats (except milk fats)[3]
Cattle, kidney	0.5			0.2 Edible offal (mammalian)[3]
Cattle, meat byproducts, except kidney	0.05			

Summary of US and International Tolerances and Maximum Residue Limits				
Residue Definition:				
US		Canada	Mexico[1]	Codex[2]
Cattle, meat	0.03			0.02 meat from mammals other than marine mammals)[3]
Goat, fat	0.1			0.07 mammalian fats (except milk fats)[3]
Goat, kidney	0.5			0.2 Edible offal (mammalian)[3]
Goat, meat byproducts, except kidney	0.05			
Goat, meat	0.03			0.02 meat from mammals other than marine mammals)[3]
Hog, fat	0.1			0.07 mammalian fats (except milk fats)[3]
Hog, kidney	0.5			0.2 Edible offal (mammalian)[3]
Hog, meat byproducts, except kidney	0.05			
Hog, meat	0.03			0.02 meat from mammals other than marine mammals)[3]
Horse, fat	0.1			0.07 mammalian fats (except milk fats)[3]
Horse, kidney	0.5			0.2 Edible offal (mammalian)[3]
Horse, meat byproducts, except kidney	0.05			
Horse, meat	0.03			0.02 meat from mammals other than marine mammals)[3]
Milk	0.1			0.07 milks[3]
Sheep, fat	0.1			0.07 mammalian fats (except milk fats)[3]
Sheep, kidney	0.5			0.2 Edible offal (mammalian)[3]
Sheep, meat byproducts, except kidney	0.05			
Sheep, meat	0.03			0.02 meat from mammals other than marine mammals) [3]
MRLs with NO US equivalent				
Barley				0.1[4]
Barley straw and fodder, dry				20[4]
Currants, Black, Red, White				5 20[3]
Gooseberry				20[3]
Grapes				0.5 3[3]
Leek				40[3]
Onion, Chinese				10[3]
Onion, Welsh				10[3]
Parsley				3
Poultry fats				0.01[3]
Poultry meat				0.01[3]
Poultry skin				0.01[3]
Poultry edible offal				0.07[3]
Strawberry				5[3]
Sugar beet				0.2
Wheat				0.1[4]

Summary of US and International Tolerances and Maximum Residue Limits				
Residue Definition:				
US		Canada	Mexico[1]	Codex[2]
Wheat straw and fodder, dry				20[4]
Wasabi		5.0		
Completed: M. Negussie; 10/18/2011				

[1] Mexico adopts US tolerances and/or Codex MRLs for its export purposes.

[2] * = absent at the limit of quantitation; Po = postharvest treatment, such as treatment of stored grains. PoP = processed postharvest treated commodity, such as processing of treated stored wheat. (fat) = to be measured on the fat portion of the sample. MRLs indicated as proposed have not been finalized by the CCPR and the CAC.

[3] Proposed MRL.

[4] Withdrawal recommended.

(c) *Tolerances with regional registrations.* Tolerances with regional registration, as defined in §180.1(l), are established for the combined residues of chlorothalonil and its metabolite in or on the following raw agricultural commodities:

Commodity	**Parts per million**
Hazelnut	0.1
Peppermint, tops	2
Persimmon	1.5
Spearmint, tops	2